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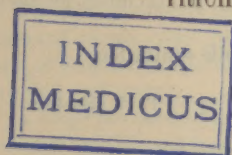
It is regretted that several typographical errors occur in this paper, but the reader can doubtless correct them without being led into error.

PLEASE EXCHANGE. A copy of any notice or criticism, also any information, which will enable the author to revise and make more complete a future enlarged monograph on the same subject, will be highly appreciated, and, as far as possible, reciprocated.

Address

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## TRICHINA SPIRALIS AND TRICHINOSIS,

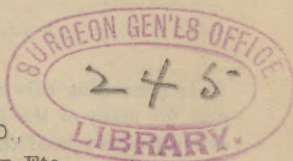


INCLUDING

# AN EXAMINATION OF INDIANA HOGS,

PREPARED UNDER THE DIRECTION OF THE INDIANA  
STATE BOARD OF HEALTH.

By THOMAS B. REDDING, A. M. Ph. D.,  
Fellow of the Royal Microscopical Society, Etc.



W. B. Burford, Printer.

NEWCASTLE, IND., January, 1885.

*E. S. Elder, M. D., Secretary of Indiana State Board of Health:*

DEAR SIR—In pursuance of the request of the State Board of Health, communicated to me by you, I undertook, on the 15th of October last, the examination of five hundred Indiana hogs, with a view to determine how extensively they might be infected with trichinæ, and to prepare a report upon the subject of trichinæ and trichinosis.

I have been able to give only evenings and odd moments to the work, being engaged in the active duties of my profession; hence, the labor has been performed under pressure for want of time, but has been as thoroughly performed as possible within the limited time given to me.

I herewith present to you my report, which embraces not only the work done since the time I entered upon this work for the State Board, but also much previous study and investigation in the same direction.

I hope the work may result in good to the cause of public sanitation.

With respect, I am yours, truly,

T. B. REDDING.

## TRICHINA SPIRALIS AND TRICHINOSIS, INCLUDING AN EXAMINATION OF INDIANA HOGS.

PREPARED UNDER THE DIRECTION OF THE INDIANA STATE BOARD OF HEALTH  
BY THOMAS B. REDDING, A. M., PH. D., FELLOW OF THE  
ROYAL MICROSCOPICAL SOCIETY, ETC..

1884—1885.

In presenting this report, I have the pleasure of acknowledging my indebtedness, for many of the facts and thoughts contained therein, to the valuable and exhaustive report of the late W. C. W. Glazier, M. D., Assistant Surgeon, Marine Hospital Service, on "Trichinæ and Trichinosis,"—1881, prepared under the direction of the United States Marine Hospital Service; and also the excellent work of M. Joannes Chatin, entitled "La Trichine et la Trichinose,"—1883, J. B. Baillière et Fils, Paris; Also to the works of Leuckart, Cobbold, Pagenstecher, Gerlach and others.

I also tender thanks to Messrs. Kingan & Co., of Indianapolis; Messrs. Baldwin & Roberts, of Newcastle, and Messrs. Collins and Welch, of the same place, for favors shown in furnishing specimens of pork; also to Dr. E. S. Elder, and others, for use of valuable books.

### IMPORTANCE OF SUBJECT—INTRODUCTION.

"My people are destroyed for lack of knowledge."—[Hosea iv, 6.

"Therefore shall the land mourn and every one that dwelleth therein shall languish with the beasts of the field, and with the fowls of Heaven; yea, even the fishes of the sea shall be taken away."—[Hosea iv, 2.



These prophetic words of Hosea, though spoken of a different subject, are as true to-day, when applied to the lack of the peoples' knowledge of sanitary laws, as when uttered by Hosea more than two thousand five hundred years ago. The cattle are dying of anthrax, tuberculosis, Texas fever and other preventable diseases; hogs are dying of cholera and trichinæ; sheep are infected with strongylus and numerous parasites, that proper knowledge, rightly applied, would prevent; our chickens and turkeys are dying of cholera and other diseases; even the fish of our rivers and seas are being poisoned by the filth poured into them by men, while men are dying of small-pox, malaria, cholera, trichinosis and many other preventable diseases; and the children are being slaughtered by the millions, while they ought to live to be old men and women, so that it might be said of our land:

"There shall yet old men and old women dwell in Jerusalem, and every man with his staff in his hand for very age, and the streets of the city shall be full of boys and girls playing in the streets thereof."—[Zech. viii, 4, 5.

That the people are destroyed for lack of knowledge is alarmingly true. Many thousand perish every year for the want of knowledge within easy reach, yet the mass of humanity lives on in willing ignorance, without an effort to know how to live well and long.

A large per cent. of diseases come to man through the use of poisonous, diseased and parasite-infected foods, and from poisonous, disease-infected water and drinks.

It is part of the work of sanitarians and Boards of Health to awaken people out of this sleep of death; to stimulate them to know themselves and their food; to choose the good and reject the bad.

One of the most distressing and fatal diseases, resulting from the use of unhealthy food, is trichinosis, infection with trichinæ, a disease that can be infallibly guarded against, if we have the knowledge to do so, and fortunately that knowledge is easily obtained. This disease has swept its thousands into the grave prematurely through intense agony and suffering, all for the lack of knowledge and inspection. There need never be another case of trichinosis, if the world will only look and see, or know and do. The rejection of all trichina-infected meats, or their thorough cooking will absolutely protect from and prevent trichinosis; but the thorough cooking, while it will kill the parasite, will not render the food as healthy as it should be for human use.

The attitude of Germany, France, Italy, and other foreign nations toward the American hog, and their refusal to give him a passport to their markets and the stomachs of their people, has touched our American people in a very tender place—the pocketbook—and far more interest has been awakened in the subject of trichinæ by this unfavorable action of foreign governments than from interests of health or sanitation.

It has been repeatedly charged by many foreign scientists and investigators, that American hogs are more generally infected with trichinæ than those of any other country. Our American investigators and scientists are not able to confirm or deny this charge for lack of sufficient observation. Very few examinations have been made in this country, and before this question can be settled there must be systematic inspection, embracing our entire country and a large number of hogs.

Not only do the interests of health and the preservation of human life demand this, but the vast commercial interests involved in our pork raising makes it less, but forcibly imperative.

Not far from forty million hogs are annually produced in our country, of which about three and a quarter millions are produced in Indiana. If these forty million hogs average two hundred pounds each, we shall have a total of eight thousand

million pounds. If 2 per cent. of these, probably a very low estimate, be infected with trichinae, we shall have one hundred and sixty million pounds of infected pork, every pound of which is capable of producing death in the consumer.

If it be true that our meats are thus infected, we have no right to complain of our uninspected pork being excluded from foreign markets. It will be wiser, far more humane, and honorable, to provide that poison meats shall neither be shipped to foreign ports, nor sold to our own citizens in our home markets; that every hog shall be inspected before going upon the market. The extreme limit of cost for a thorough inspection for trichinae need not, in any case, exceed the one-tenth of one cent per pound, or twenty cents per hog, and can probably be done for less than one-fourth of this sum—a very small expense compared with the safety secured at home and the advantage of the freedom of foreign markets.

But the advantage of proper inspection, investigation and oversight, in this direction, will not only conduce to the health and safety of our own people, and open to us the markets of the world, but will increase largely the demand for American inspected meats, and, at the same time, will enable and stimulate our farmers and all persons interested in pork raising, to so feed, manage and handle their hogs as to reduce the infection to its lowest limit and, probably, ultimately to entirely stamp it out of existence among us.

In order to present the subject of trichina and trichinosis so as to lead to a full comprehension of its importance in every relation, I shall give, not only the results of my examinations of Indiana hogs for trichinae, under direction of the State Board of Health, but, also, a brief history of the discovery of the parasite; its natural history; a description of the processes of infection of men and animals; symptoms of the disease called trichinosis; methods of prevention; statistics of epidemics, and of examinations; methods of inspection and study, and a list of the principal authorities upon the subject.

#### EXAMINATION OF INDIANA HOGS.

About ten years ago my attention was directed to the necessity for the examination of all pork used as food. Since that time I have not allowed any pork to be used in my own family that was not first submitted to microscopical examination for trichina spiralis. During that time, and up to October 15, 1884, I examined in all, probably as many as two hundred different animals, but of most of these examinations I kept no record. In this report I shall only include such examinations as I made records of at the time. Since October 15, 1884, I have examined the flesh of five hundred and fifty hogs.

I shall not give details of the several examinations made, further than is necessary to present the results, but can furnish them, if desired, at any time.

"In 1881 I examined twenty hogs and found trichinae in two, one of them exceedingly full; in 1882 I examined twenty-five and found but one that contained any of the parasites. Last year I examined, at various times during the year, fifteen, and found one that contained trichinae; these were hogs that had been killed and were sold on our market. I also, during the past winter, examined the muscles of three hogs that had died and were left on the street a few days, and found trichinae in each of them in great abundance; they were fed in very dirty pens and where rats greatly abounded." (216 p. 45.)

In nearly all cases I examined five sections from each hog. The sections would average nearly three-quarters of an inch square, and from the 1-100 of an inch to 1-150 of an inch in thickness. Many times I examined more than five sections to the hog. The methods of examination are given elsewhere more fully.



From October 15, 1884, to December 31, 1884, I examined the flesh of fifty-two hogs, received from the meat market of —, at —. They kill, mostly, young hogs, ranging from nine to eighteen months old. The first twenty-four examined were free from trichinae. The twenty-fifth, a hog about eighteen months old, raised on a farm about two miles from town, contained numerous encysted trichinae.

The thirty-ninth, forty-sixth, forty-seventh, forty-eighth, forty-ninth, fiftieth, fifty-first and fifty-second hogs examined, contained trichinae. The others were free. The fiftieth and fifty-first not only contained recently encysted, but numerous non-encysted and embryonic trichinae; some just entering the muscle fibers; others yet in the connective tissue. Numbers forty-six to fifty-one inclusive, had been fed a few weeks in the lot adjoining the slaughter house, and had been fed, partly, upon the offal of slaughtered animals and probably were infected from that source. They were all recent cases. Number fifty-two contained an immense number of trichinae in the abdominal muscles, and a moderate number in the muscles of the back. The butchers assured me that numbers forty-six, forty-seven and forty-eight would be free from parasites, as they had raised them themselves. Upon learning from them that they had been fed as above, I was quite sure that I would find them infected, and the microscopical examination abundantly corroborated my suspicions. They were much surprised when I told them the result and explained to them the probable source of infection, and assured me that they would not thereafter feed hogs upon the offal of butchered hogs.

On the 25th of October, 1884, I received from Messrs. Kingan & Co., of Indianapolis, specimens of 300 hogs, taken from the psoas muscle, or tenderloin. The first 175 specimens examined contained no trichinae. The 176th, 218th, 219th, 226th, 230th, 233d, 242d, and the 267th specimens contained encysted trichinae. Most of these contained from one to five trichinae to each five sections examined. Nos. 218, 230 and 242 were very full of encysted trichinae. No. 130 showed some cysts partly calcified. The other specimens examined were not infected. Total examined, 300; infected, 8, or  $2\frac{2}{3}$  per cent. I was not able to learn any particulars as to the age or methods of feeding this lot of hogs.

I have examined specimens from 176 hogs received from the pork house of Messrs. Baldwin & Roberts, the second largest establishment in the State. In the first twenty-six I found no trichinae. In the twenty-seventh I found enormous quantities of encysted trichinae. This specimen contained probably 12,000 to 20,000 parasites to the cubic inch of muscle. A small section about half an inch square and about 1-150 of an inch in thickness, contained thirty encysted trichinae.

Among others examined I found one with encysted and embryonic trichinae, and six recently infected cases containing in the intrafascicular tissues large numbers of embryonic trichinae. Two of them were extremely full of these embryos. In most of the specimens muscular degeneration had commenced, and many of the embryos had entered the fasciculi, and the first, or preparatory, processes of encystment had commenced. It is probable that these recently infected hogs had been kept a few days in the yards where large numbers of other hogs had been kept, and were infected from this source; but as I could not trace their history, I can only speculate upon the source of infection.

I examined, during the year, twenty-two hogs from other sources, one of them containing encysted trichinae.

Total examined, 550; infected, 25; equal to a fraction over  $4\frac{1}{2}$  per cent.

The highest percentage of infected hogs were those of the retail butcher shops, in which, out of fifty-two animals examined, nine, equal to about  $17\frac{1}{3}$  per cent.

were infected. In this case the animals intended for sale were kept from a few days to several weeks about the slaughter house, and fed upon animal refuse and offal from slaughtered animals. No doubt this was the source of infection in most of the cases. How many more retail butchers throughout the State manage in the same way? I have no hesitancy in predicting that in all such cases a large percentage of the hogs killed will contain trichinae.

#### METHODS, INSTRUMENTS, ETC.

I have used in my investigations Beck's microscope stand, No. 44, with mechanical stage, achromatic substage condenser; Beck's 1,  $\frac{3}{8}$ - and  $\frac{1}{2}$ -inch objectives; Beck's oculars, A, B, C and D; Tolle's first quality duplex four system immersion,  $\frac{1}{10}$ -inch, objective of 180° angular aperture; Tolle's  $\frac{1}{2}$ - and  $\frac{1}{4}$ -inch oculars and amplifier; Gundlach's  $\frac{1}{10}$  objective of 110°.

When examining merely to determine the presence of trichinae, I used a  $\frac{3}{8}$ -inch. objective and 2-inch eye-piece, giving about 75 diameters, or the 1-inch objective, with same eye-piece, giving about 60 diameters. These are as high powers as should be used for the detection of the presence of the parasite. The higher powers were only used in the study of the structure, histology, and other facts relating to the life-history of the trichina, and the formation of its cyst, etc. Having ascertained, in certain cases, that I had a specimen of a very recent invasion by the parasites, in their embryonic state, I resorted to the higher powers, ranging from 250 to 2,000 diameters, for their more complete study and investigation. I also used like powers in my studies of the intestinal trichinae, their ovules, and the development of the ovules prior to their birth.

The apparatus and lenses used were all first-class, and every reasonable precaution was taken to prevent any errors of observation. My work has been done slowly and cautiously, from the first, and I trust my observations have been correct. Had more time, however, been allotted to the work than has been possible since I was requested to undertake it, I think my report could have been made more valuable by including much that is necessarily left out.

The flesh for examination was generally taken from the psoas muscle, or tenderloin, and from the pillars of the diaphragm. Other parts have occasionally been used. The sections have sometimes been prepared by freezing the muscle and then cutting in the microtome; at others by using a Valentine knife, but most frequently by taking a thin, ribbon-like piece of the muscle running parallel with the fiber, and placing this in the "Bausch and Lomb" compressor, No. 1,009, and by its use spreading and thinning the muscle for examination. This compressor is admirably suited to this work, and enables one to prepare specimens for examination quite rapidly. Sometimes it may be an advantage to moisten the specimen with a small drop of a solution of one part of liquor potassae to seven or eight parts of water, or a solution of glacial acetic acid, one part to six of water. These make the specimen more transparent and facilitate the spreading and thinning of the tissues, but I seldom find it necessary to use anything of the kind. I have often used the various staining reagents, but they are not necessary except to facilitate the histological study of the parasite and its cyst. If the specimen has been in salt, or other hardening reagent, the section should be allowed to soak in pure fresh water a short time before examination, and then treated with a drop of the potassic or acetic acid solution. The use of a mechanical stage and achromatic substage condenser facilitates the examination of every part of the tissue with the most favorable conditions as to light, the condenser enabling us to readily modify the light to



suit all the conditions of the tissue. In order that an inspection may be accurate and exhaustive, revealing all that is to be seen, the lenses used should be of the best quality, the light should be under perfect control, the sections should be taken parallel with the fibers of the muscle, and should be thin enough to allow perfect illumination—say from  $\frac{1}{100}$  to  $\frac{1}{200}$  of an inch in thickness—and be mounted upon a suitable compressor or upon a glass slip with suitable glass cover. If the tissue to be examined is dry, or not fresh, the sections should be moistened with one of the solutions named above, or with water and glycerine, equal parts.

To obtain intestinal sexually perfect trichinae, their eggs and embryos, I fed cats, rats and mice trichinized flesh, and killed them at different intervals, commencing twenty-four hours after ingestion and extending to twenty days, and in one case six weeks. In this way the parasites were obtained in all stages of development. In this report I have had time only to give general results, and can not give details of the several examinations.

It should be understood that all these tedious processes of investigation are not necessary merely to detect trichina in the flesh of the hog, but are necessary to one who desires to know the life-history of the parasite, the method of encystment, the histological and pathological changes that take place, and the effects upon the animal.

#### REFERENCES AND BIBLIOGRAPHY.

The references to authorities in the following pages are by numbers, referring to the authors named in the bibliography. Thus, (46) refers to bibliography "46, Colbold on the Discovery of Trichina, etc., *Lancet*, 1866."

The bibliography at the close of this article is as perfect as I have been able to make it from the material at hand and in the time at my command. No bibliography has heretofore been given by any American writer upon this subject, and I trust this will serve a useful purpose to American students.

Titles of works are given without translation, as is best, and saves confusion and mistake in ordering books.

#### PSEUDO-TRICHINÆ.

It is not every parasite, found in the flesh of animals, that is a *trichina spiralis*. Investigators have described nine species of the trichina, some of them, probably, incorrectly classed as such. The species and names of the investigators who named them are given below, to-wit:

*Trichina spiralis*: Owen. (200.)\*

*Trichina affinis*: Diesing. (68 A, t II, p. 114.)

*Trichina cyprinorum*: Diesing. (Same, p. 115,) also (70, p. 60-61.)

*Trichina cystica*: Salisbury. (235, t IV, 1868, p. 376.)

*Trichina inflexa*: Dujardin. (70, p. 294.)

*Trichina Microscopica*: Polonio. (214, A.); see also, (176 *Gaz. Med.* 4 June, 1881.

*Trichina agilissima*: Molin. (189 A, p. 16.)

*Trichina circumflexa*: Polonio. (214 A.)

*Trichina anguillæ*: Bowmann. (169 A.) See also, (68 A, t 2, p. 115.)

For the distinguishing differences between these nine so-called species of trichina, I would respectfully refer the reader to "La Trichine et Trichinose Par Joannes Chatin," 1833, Paris, (39)\* and the authorities above referred to.

\*Refers to numbers in Bibliography, which see.

There can be little danger of any one being led astray who has studied the *trichina spiralis* as it usually appears in the hog, especially in its encysted state. But there are other objects, that may be called pseudo-trichina, that may lead the non-expert into error. One of the most common of these, which is very often found in the hog, is the *psoro-spermia*, sometimes called "Rainey's sacs." A little attention, however, will avoid any mistake. Psorosperms are granular, elongated bodies lying within the sheath of the muscle fiber. The fiber, in the case of the psorosperm, retains its transverse striation, not only on either side of the enclosed body, but extending directly from the extremities, while the trichina entirely destroys the striation, especially at the extremities. Inexperienced observers might, also, possibly mistake the *strongylus paradoxus*, and the *str. filaria*, for trichinae. The first is found in the air passages and lungs of some animals, and the second is found in the sheep of Texas, and elsewhere. Other parasites that have, possibly, sometimes, been mistaken for trichinae are the following: *Spiroptera strumosa*, *spiroptera erinacei*, *spiroptera obtusa* of the rat and mouse, *physaloptera clausa* of the hedgehog, the *ascaris* of the mole, the *spiroptera* of insects, the *filaria sanguinis*, the *anguilula* or vinegar eel, *tricocephalus dispar*, *cysticerci*, and probably a few other similar organisms. But it is only the inexperienced observer that will be likely to be misled by any of these. Space will not allow me to describe the distinguishing characteristics of these several parasites, etc. Some of them will be found illustrated in Dr. Glazier's report. (111). See, also, Chatin, (39).

The principal danger of mistakes will be in cases of fresh invasions, where the trichinae is still in its embryonic state. While in this stage it is not capable of producing trichinosis in any other animal through eating of the muscle tissues. But where hogs feed with others, or eat of the viscera of dead animals, or the excrement of other animals containing living females and embryos, they may, by so doing, receive into the stomach the newly born embryo, or the female containing young, and, possibly, thus become infected.

#### TRICHINA SPIRALIS—HISTORY OF DISCOVERY.

In 1821-2 Tiedemann (269) described calcareous concretions found in the body of an intemperate person, who had suffered severe and frequent attacks of what had been taken for gout. These concretions are supposed, by some, to have been calcified trichinae cysts, but the description show them to have been of different sizes from trichinae cysts.

In 1828 indications were noticed in the human muscle by Peacock, and in 1829 by Klencke, which may possibly have been caused by trichinae, but scarcely merits notice as a discovery. (39.)

The history of the discovery of this parasite may be divided into two periods: the first from 1832 to 1835, and the second from 1858 to 1860; the first English, the second German. The first described the parasite in its larval, or encysted condition; the second disclosed its life history. (39.)

In 1832 Dr. Hilton (122) described certain gritty particles found by him in the body of an old man who had died of a cancerous affection, which he attributed to parasitic origin, possibly *cysticerci*, but the proof that trichinae were present is not conclusive.

In 1834 Sir James Paget (208), then in St. Bartholomew's Hospital, first observed the trichina coiled up in its cyst. He submitted it to a rigid microscopical examination, and described the same as he found it. Dr. Wormald, in the same hospital with Paget, the following year submitted to Dr. Richard Owen specimens



of the same flesh examined by Paget, with a description of Paget's discoveries and diagnosis. Dr. Owen (200) fully confirmed the diagnosis and fixed definitely the taxonomic place of the parasite and gave it the name "*trichina spiralis*," a name now almost universally recognized in all languages where it has been described. The name is from the Greek word *thrix* ( *θρίξ, τριχός* ) a hair, and the specific name, *spiralis*, because coiled up in its cyst in a spiral.

Owen's and Paget's descriptions were, however, very incomplete and gave rise to a good deal of discussion as to the place this parasite should occupy in natural history, as well as concerning its structure. (On this subject consult 163, 128, 80, 243, 46, 64, 18, 173, 278.)

For nearly twenty years the history of the *trichina spiralis* remained almost stationary.

In 1835 Farre (80) described the intestinal tube and its three divisions, and recognized the ovaries. Bischoff confirmed these discoveries, and Luschka discovered that the slender end was the head. Bristowe & Rainey, Küchenmeister and others, made still further discoveries in its life history, and in 1859 Virchow described the sexually mature worms. Leuckart somewhat advanced our knowledge of the subject during the same year, and efforts were put forth in various directions, by experiment and observation, to fully make out the life history of the parasite.

In 1860 Dr. Zenker treated a case of supposed typhoid fever, a girl aged about nineteen, who had been sick about twenty days. She complained of great fatigue, loss of appetite and intense thirst; there was some fever, swelling, abdominal pains, and most of the usual symptoms of typhoid fever, for which the case was treated, but there were also pains, limited at first to certain muscles, then becoming general and incessant, persisting day and night, then followed violent and painful contractions of the limbs resisting every effort at extension. The girl entered the hospital on the 12th of January and died on the 27th of the same month. The anomalous symptoms had been carefully noted by Dr. Zenker. An autopsy was held, and a careful and minute microscopical examination made of her voluntary muscles, which were found filled with encysted trichinae. The autopsy showed that certain lesions, peculiar to typhoid fever, such as alterations of Peyer's glands, were lacking, and a microscopical examination of the intestinal contents showed "numerous nematodes reproducing the taxonomic character of *trichina spiralis*, but having attained their complete development." (39.)

Dr. Zenker, stimulated by his discoveries, made a rigid examination of all the circumstances and conditions under which these parasites had entered the organism and quite thoroughly reviewed the etiology of trichinosis. His discoveries were extensively published and stimulated research. He called the disease *trichinenkrankheit*, or *trichina sickness*. (300, 39.) He visited the girl's parents and obtained from them the facts relating to the origin of her disease; learned that she had eaten of pork at a certain time, bought at a certain shop; he visited the butcher who had supplied the meat, and found that he had a charge for pork sold the father at the date named, and that the butcher had himself eaten of the meat, and had been made very sick, but that he had thrown it up; he also learned that a number of other persons had been made sick by eating of the same pork. The butcher came to the conclusion that the meat was not healthy, and refused to sell any more of it, and had laid away the portion remaining unsold. Dr. Zenker obtained some of this pork from the butcher. He examined it under the microscope and found it filled with trichinae. These discoveries furnished the means for unraveling the mystery. The girl had eaten of the trichinized meat; the cysts were dissolved in the stomach;

the larval trichinae were set free and developed sexually; the females gave birth to a numerous progeny; these embryos, finding their ways into the muscles, gave rise to the final symptoms, as observed by Zenker.

These discoveries determined him to make a series of experiments. He fed the infected meat which he had obtained of the butcher to various animals, and in them reproduced all the characteristic symptoms of his trichinenkrankheit, or trichinosis.

By these experiments the developmental cycle of the trichina, its mode of propagation and dissemination, the etiology and prophylaxis of trichinosis were elucidated in a most complete and brilliant manner. (39.)

Cobbold, (52 p. 152) in speaking of Dr. Zenker's experiments and discoveries, says: "Never in the history of biological science have more valuable issues followed the method of experiment upon animals. Not only has human life been thus saved, but animal life also. State medicine and sanitation have received an immense impulse. The good that has already resulted is incalculable."

*Trichina spiralis* was first found in the hog by Prof. Leidy, of Philadelphia, in 1846. (160 p. 107 and 159 p. 353.)

Space will not permit me to further trace the history of discovery.

#### MALE AND FEMALE TRICHINA.

The trichina as found in the cyst is not complete in its development. It is a larval form of the perfect worm. Before it can become perfect it must be freed from its cyst by entering the stomach of some animal suitable to its development. While the trichina remains in the cyst it does not multiply, nor grow, nor change its position. If a piece of trichinous flesh be eaten by man, or any animal in which it may find suitable environments for development, the gastric and other fluids of the stomach, within two to five hours, dissolve the walls of the cyst enclosing the parasite, which is thus set free within the stomach. When thus freed, it rapidly develops into its mature and perfect state. After becoming free, the trichinae pass into the small intestines. Then commences the rapid increase in size of the worm by the development of the sexual organs, and thus the increase of its length is limited principally to its posterior portion, while the anterior increases in diameter only, and in twenty-four hours, after feeding, they may have increased one-half their former size, and are, for the most part, capable of procreation." Some of the capsules may remain undissolved in the stomach two or three days. Most of the trichinae will, however, be found sexually mature within three days.

The full-grown male trichina is from  $\frac{1}{20}$  to  $\frac{1}{15}$  of an inch in length and about  $\frac{1}{800}$  of an inch in diameter; the full-grown female is from  $\frac{1}{8}$  to  $\frac{1}{7}$  of an inch in length and about  $\frac{1}{500}$  of an inch in diameter. The posterior part of the female continues to enlarge after sexual maturity for some time, to make room for the large number of eggs produced.

Copulation takes place within about fifty to sixty hours after the worms are set free, and within fifty-four to ninety hours, most, if not all of the females are pregnant, and within five days the embryos begin to be born. These processes may continue for two weeks or more. (Consult Pagenstecher, Delpeche, Cobbold, Leuckart and J. Chatin.)

The outer cuticle of the trichina consists of a delicate, thin, transparent, structureless, annulated, chitinous membrane, about  $\frac{1}{25000}$  of an inch in thickness. The rings are more easily seen in the muscle trichina coiled up in its cyst than in the



mature worm. Just beneath the outer covering is a striped longitudinal layer of muscular tissue. On the inner side of this layer, closely pressed together, is a strata of finely nucleated cells, which constitute the lining of the abdominal cavity.

The mouth is terminal. The body is curved in one direction, and, "if we recognize the female genital opening as being on the ventral surface, the curve is uniformly towards the dorsal side." The terminal hooks of the male are found on the convex or ventral side, attached on either side of the anus by broad round bases.

The internal organs consist of an intestinal canal, organs of reproduction and a brain. The canal is very closely alike in both sexes. It is divided into three parts: The first in the anterior part of the body; the second, less constricted, in the central part of the body, or rather forward of the central part; and the third part, which occupies the posterior third and part of the middle third of the body. The stomach composes the anterior part of this last portion.

The brain is a small mass of round ganglion, nucleated cells, surrounding the œsophagus, and from this brain a few very fine nerve fibers may be traced a short distance.

The sexual organs of the male are developed while in the larval state, but the contents are not matured till his liberation. The hooks are also partly, if not wholly, developed after his liberation from the cyst. In the female the reproductive organs are but partly or imperfectly formed in the larval state, but fully mature within two or three days after being set free.

The female reproductive organs consist of an ovary, a uterus and vagina, all lying in an almost direct line, and the uterus, in the fully matured specimen, merging gradually into the vagina. The eggs, or ovules, are produced along the whole length of the ovary on one side, appearing in the earlier stages closely pressed together like a narrow band of minute cells. As they increase in size they become detached and move to the center and opposite side of the ovary. The ovules are spherical, have a germinal vesicle with a comparatively large nucleus, surrounded by a clear vitellus and an exceedingly thin limiting membrane. 39%.

The seminal elements, after copulation, occupy such a position in the uterus, that the ovules, in passing out of the ovary into the uterus, must pass through the sperm, by which they are then impregnated. When thus vitalized, the ovules gradually pass downwards towards the vagina, developing as they progress. When near the beginning of the vagina the young trichina has so far developed within the ovule as to be ready for liberty and bursts the delicate wall or membrane confining it and escapes as a bent or curved embryo. As the embryos advance toward freedom, they straighten out and lie, one behind another, in single file, and passing out through the vagina, are born, one by one. The birth of these embryos usually takes place within five days after copulation, or within six to eight days after the infection and liberation of the larval trichina within the stomach. But as all of the ovules do not mature and become impregnated at the same time, the embryos continue to be born, sometimes for one or two weeks, or even longer.

The female develops a very large number of eggs. Often 400 to 600 impregnated eggs and embryos may be found in the uterus at a time. This may continue for weeks after the birth of the young commences. On this account it is not very difficult to observe the successive stages of ovule development. It has been claimed that ova have been seen attached to the wall of the ovary eight weeks after infection. It is estimated that one female will give birth to two thousand, or more, young trichinae. The embryos are born one to three each hour.

The processes of development of the egg of the trichina are very beautifully illustrated in plate two, figures 6 to 22, and the further development of the embryo

in plate three, figures 23 to 33, of "La Trichine et Trichinose, par Joannes Chatin," Paris, 1883. (39.) I should be glad to reproduce these exquisite plates here, if it could be done, but must refer those who wish to study this subject to the above work.

The entire development of the ovule occupies about three days. The female commences giving birth to her young possibly as early as the fourth day, in some cases, and may continue until the twelfth week, but usually not so long. Did circumstances permit I should be glad to more fully describe the histological elements, the anatomy and reproduction of the trichina.

The embryo, before birth, in its developed condition, is about  $\frac{1}{25000}$  of an inch in length and about half as much in diameter. While in the body of the mother it has the appearance of a delicate granular thread, but afterwards becomes more transparent. At this period the extremities are so much alike that it is difficult, if not impossible, to determine which is the head; but this stage soon passes away. Sometimes in the oldest embryos a delicate cuticula and an axial beaded line can be distinguished. (Pagenstecher.)

In the intestine embryos have been found of nearly all sizes, from  $\frac{1}{10000}$  of an inch to  $\frac{1}{2}$  of an inch, and with a diameter reaching  $\frac{1}{30000}$  of an inch. "The size and appearance of those embryos that migrate to the muscles, remain unchanged during migration. The first changes in the migrating worms are observed after they have reached the fasciculi and take on a condition of rest. (Leuckart.) From the intestines most of the embryos soon migrate to other parts of the body. They are first found in the abdominal and pleural cavities and pericardium, and so constant is their appearance in these cavities that these "may be considered their normal stations." (Leuckart.) They are generally most abundant in the abdominal cavity. From these places they speedily migrate, probably in part through the openings which serve for the passage of the oesophagus and the large blood vessels, and partly through the walls of adjacent parts, and possibly through the blood—though this is doubtful—to the surrounding connective tissue, and thence into the muscles of the various parts of the body. They may often be found free in the loose connective tissue of various parts. Following this loose connective tissue that binds together muscles and other tissues, they find ready access to the remotest parts of the body within a few days after the migration commences. The duration of the migratory period has not been definitely determined, but probably does not continue more than eight to ten days. (103, p. 13. 168, p. 568.)

Sometimes the embryo may be found in the muscle fiber before any apparent change has taken place in the fibre, which indicates a very recent arrival, for degeneration commences in the muscle fiber almost immediately upon the embryo entering the fiber or its sheath.

On the 28th of November, 1884, I examined a specimen from the pillars of the diaphragm of a hog which had been fed, a few days previous to killing, upon offal from the slaughter-house. I found in the loose connective tissue great numbers of free embryonic trichinae, and also numerous changed muscle fasciculi into which they had penetrated. More than 100 free embryos, and 25 encysting embryos, were found in a section about  $\frac{1}{4}$  of an inch square and  $\frac{1}{2000}$  of an inch in thickness. The section embraced the loose connective tissue between two adjacent bundles of muscles. I examined these with powers ranging from 75 to 1,000 diameters. It is only with careful manipulation and good lenses that the embryo can be identified when it has so recently entered the fasciculi. I have found free and non-encysted embryos in large numbers in more than a dozen different hogs.

When the embryo enters the muscle fiber and becomes encysted therein, or,



rather, when it commences that process, it "destroys the inner part of the fasciculus, not only in its immediate vicinity (Leuckart) but, sometimes, to the extent of a quarter of an inch in length." "This destruction consists of a morphological metamorphosis; \* \* \* the fibrillar substance degenerates to a fine granular detritus, and all that can then be distinguished are the neuclei, which appear as small oval bladder-like bodies from  $\frac{1}{1000}$  to  $\frac{1}{2000}$  of an inch long and  $\frac{1}{3000}$  of an inch in diameter, with a sharply defined wall, and with sometimes single and sometimes double solid neucleoles," (Leuckart.)

Neuclei are always more numerous in degenerating than in normal muscle fasciculi. This degeneration renders the fibrilla more or less opaque, and "it appears as a dark thread-like stripe." It also loses its elasticity or contractility, and, owing to this condition, will often be found projecting a short distance beyond the cut ends of the sections.

Various theories have been advanced to account for this degeneration of the muscle tissue. Some consider it due to the progress of the parasite through the tissues; others, that the parasite consumes the substance of the tissue; but as it receives its food in a liquid form only, by endosmosis, probably, this can hardly be true. Probably the regressive changes are due to irritation and inflammatory processes caused by the presence of the parasite. At the same time this degeneration is progressing there occurs a growth of small cells in the neighboring connective tissue, extending the whole length of the sheath and often beyond to other fasciculi. Changes also take place in adjacent capillary vessels to the extent of interfering with the distribution of the inflammatory products. (Colberg,) (53.)

When the embryo reaches the muscle fiber it enters upon a state of comparative, if not complete repose, and rapidly grows to its normal size as a muscle trichina. After entering the muscle a vibratory or exploring motion of the anterior extremity has been observed, by a few observers, for a short period of time, but I have never been able to see any such motion. In twelve to fourteen days after entering the muscle the embryo attains its full size and becomes a larval, or muscle trichina.

As the worm grows it exhibits differentiations of its internal organs. As it increases in length it becomes more slender anteriorly, and begins to coil into a spiral, often commencing thus to coil when not more than  $\frac{1}{1000}$  of an inch in length. The outward pressure of the worm causes the muscle sheath to enlarge around it, and owing to the elasticity of the sheath, the cavity assumes a spindle shape. In two to three weeks, or less, the worm ceases to grow, and a bright halo will be seen surrounding it, which is now sharply limited by the enclosing muscle, and is the optical expression of the enlargement. (Leuckart, as quoted by Glazier.)

In the fifth week may be seen the first traces of the cyst proper. And after about seventeen weeks the cyst has a clearly defined outline and is fully formed. It is sometimes fully formed earlier than this, possibly; in some cases as early as the sixth week.

In progress of time the capsules become rounder and shorter with more or less fat globules, first at one end, and afterwards at the other. After eighteen months, and in some cases as early as the thirteenth month, calcification, the deposit of lime and mineral matter, commences to take place. In some animals, the rabbit for example, calcification has been known to commence as early as the eightieth day (206, p. 96), and several observers claim to have seen calcification in the hog within three to nine months after infection. (163, p. 67; 206, p. 9.)

Leuckart (163, p. 67) substantially describes the process of calcification as follows: There is, at either pole of the capsule, first a collection of minute calcareous

granulations, at first assuming a spread-out, or flask shape. After sometime these particles become a homogeneous mass, having the form of a disk and lying between the layers of the capsular wall. Sometimes this takes place at one pole only. It is readily distinguished from the other elements of the cyst by its difference of refracting power.

After several years the cyst may become quite opaque from these deposits. The polariscope will aid us in determining the presence of these mineral deposits.

After calcification has taken place, the cysts can be seen with the unaided eye, in a thin microscopical section held up between the eye and the light, as minute white specks. I have a specimen of human muscle in which they may thus be recognized. By macerating such a specimen in dilute hydrochloric acid the mineral salts are dissolved, and the cyst, with the contained worm, rendered transparent.

As a general rule the cysts in the hog are not found calcified, owing to the fact that hogs are killed while young before that process commences. Among the six hundred or more animals that I have examined, I have found two only that contained calcified cysts.

#### IN WHAT ANIMALS FOUND.

Trichine have been found in quite a number of different animals, mostly mammals. Without citing authorities, I enumerate the following animals in which they have certainly been discovered, viz.: The hog, cat, dog, rats, mice, rabbits, hippopotamus, and in man. Also in young horses and cattle, when artificially infected. They are reported to have been found in the ape, the crow, the badger, marmot, marten, mole, polecat, raccoon, geese, trito cristatus, hedge-hogs, salamanders, eels, sheep, the hen, fish, and frogs. Doubtless some of these last are cases in which other parasites have been mistaken for trichinae. It is probable that trichine never become encysted in the flesh of birds, and are never found in the batrachians and reptilia under normal conditions.

The best authorities agree that trichinae do not become encysted in birds, but intestinal trichina, male and female, and their embryos, are readily obtained from the intestines of birds, including our domestic poultry, after feeding them trichinous flesh, but for some reason, not yet understood, they do not migrate to the muscles and become encysted, as they do in men, hogs, and some other animals.

M. Chatin is of the opinion that reptiles and batrachians do not become trichinized, because of the temperature of their bodies not being suitable to the development of the parasite, and that their immunity depends solely upon the variable temperature of their bodies, and says that when the temperature is maintained artificially at 30° (Cent.), we may have not only perfectly developed sexual trichinae, but also the larva migrating into the intrafascicular tissues, but as soon as we abandon the subject to the surrounding temperature, it ceases to offer the conditions necessary to these parasites. (39, pp. 82 and 85.)

If these views be correct, it is sufficient to account for the occasional appearance of the trichinae, temporarily(?), in these animals.

I found in the pectoral muscles of a frog, taken from a branch into which the washings, etc., from a large pork-house flow, a large number of encysted parasites, coiled in a spiral, and very closely resembling the trichina spiralis. The cysts were, however, nearly circular and quite different from those found in the hog. At the time I supposed them to be trichina spiralis, with modified cysts, and in my paper before the Sanitary Convention at Anderson, Ind., April, 1884, (216), stated that I had found trichina in the frog; but upon a more thorough examination of



the parasite thus found, I am satisfied that it is not a *trichina spiralis*, but a different species, which I am not prepared to name at this time. I had injected the frog with a view to studying certain parts of the viscera. Observing a thin section of the pectoral muscle to present a peculiar appearance, I mounted and examined it as a matter of curiosity. The remainder of the body had in the meantime been thrown away, before the discovery of the parasites; hence it has been impossible to verify all the points that should be verified to make a clear case. The frog was caught in the warm weather of July, and was kept in a pail of water three or four weeks, at a temperature of summer heat. This may have had something to do with the development of the parasites and the incomplete and imperfect cysts inclosing it.

Cats are very frequently infected with trichinae. "Two years ago a cat, living at my barn, had five kittens. When the kittens were about eight weeks old, the mother sickened and died; about the same time the kittens also became sick, and one after another died. I examined pieces of the muscles of the mother and each of the kittens, as they died, and in all I found vast multitudes of encysted and encysting trichinae, and great numbers of free trichinae in the stomach and intestines. A short time before the mother-cat sickened, I found her and her kittens making a meal off a large rat which she had killed, and which was probably the source of infection." (216.)

Two out of six other cats examined by me contained trichinae. "Herbert found trichinae in the cat in 1845, and Guelt in 1849." (111.) Dr. Seiler, of Philadelphia, told me a few years ago that he had seldom or never examined a cat at Philadelphia that did not contain trichinae. In Dearborn and Ohio counties, Indiana, three out of four cats examined were full of trichinae. Voget, Rupprecht, Kühn, and numerous other authorities, report having found trichinae in cats. (286 B., p. 409, note; 112 B., p. 114; 163; 151 A.) [See Addenda.]

#### PARTS OF BODY INFECTED.

The encysted trichinae are always found in the voluntary muscles, and not often elsewhere. They are sometimes found in the adipose tissue adjoining the muscles. (39, pp. 87-93.) Those muscles adjoining the abdominal cavity are usually the most infected, especially the pillars of the diaphragm and the psoas, or tenderloin muscles. If half a dozen sections of either of these muscles be examined and no trichinae found, it will be pretty safe to conclude that the animal is not infected; yet these muscles may, in some cases, be almost or entirely free from the parasite, while others are infected, but such infections are generally quite light. The heart is nearly exempt from the invasion of the trichinae, only a few having ever been found within its muscles.

Before encystment the embryos and migrating worms may be found in the intestines, in the pleural and pericardial cavities, in the connective tissue and muscle fibers.

The central part of a muscle may be almost free from the worms, while the ends, or those parts near the tendons, are quite full.

In making examinations it is best to take that part of the muscle near its origin or insertion. It is best, also, to examine the pillars of the diaphragm, or the psoas muscle first. If no trichinae are found in these, it is not probable that they will be found in other parts of the body.

No domestic animal suffers more from contagious diseases than does the hog. It is estimated that the losses in the United States for 1877, occasioned by diseases of this animal, amounted to more than twenty million dollars, and for 1878, to

more than thirty million dollars. As is shown elsewhere, the hog is made sick by the invasion of trichinae, and, doubtless, in many cases his sickness, from this source, has been attributed to cholera, or some other disease. The cholera is a very distinct and different disease, however. With many hog raisers the temptation is very great, when a few of their hogs become sick, to hurry them into market or the pork barrel, for some one else to consume. It is unquestionably true that much diseased meat, of various kinds, is exposed for sale in our markets—far more than consumers imagine.

#### NUMBER OF HOGS INFECTED.

It is probable that in every part of the world where hogs exist they are, to some extent, infected with trichinae.

Gerlach gives a table of 664 infected hogs, found principally in Germany, from 1864 to 1874, inclusive. (104.)

In the Duchy of Brunswick, from 1866 to 1876, 781,611 hogs were examined, of which 125 contained trichinae—250 were otherwise diseased and unfit for food. (111.)

Berkau states that of 60,000 hogs killed in the four years preceding the year 1863, in Brunswick, seven were infected. In Blankenburg 8,000 were examined and nine found infected. Fifteen were found infected from other parts of the duchy. (14.) Of 67,427 hogs examined in Rostock, 1867-1877, 42 contained trichinae. (Petri.) (212.)

Of 391,913 hogs killed in Gotha, 1865-1876, 46 contained trichinae. (Schuchardt.) (239.)

In 1876, 1,728,595 hogs were examined in Prussia, of which 800 contained trichinae. (78.) The highest degree of infection found in Guessin was 1 to 141.

In 1877, 2,057,272 hogs were examined in Prussia, and 701 of them contained trichinae. (100.)

In Stockholm, 1865-1875, 81,363 hogs, including whole hogs, halves and hams, were examined, and 143 were infected. (289.)

Of 8,174 hogs examined in Copenhagen, 15 were infected. (140.)

In Russia of 3,550 hogs examined 5 contained trichinae. (145.)

In all places where examinations have been made, hogs fed in cities contained more infected animals, in proportion, than those fed in the open country.

In 1879, 3,164,656 hogs were examined in Germany by 14,413 experts. American hogs were found to contain trichinae in the proportion of 2 per 100; indigenous hogs 1 to 9 per 100. Nine per cent. of those examined were measly. (39, p. 209.) Measly pork is the source of infection for the tape worm, the larval form of this worm, *cysticercus*, causing the measels in hogs, and developing into tape worm in man.

In France, of 50,210 pieces examined, 993 contained trichinae. Of 53,318 pieces examined, 1,087 contained trichinae. These purport to be from American hogs. (39.)

No trichinae were known to exist in Europe prior to 1830; but, no doubt, it was owing to a want of observation and knowledge, rather than to their absence. It is probable they existed there long before, and that many persons died of trichinosis, whose deaths were attributed to other causes.



## TRICHINÆ IN AMERICAN HOGS.

There has, as yet, been no systematic examination of American hogs for trichinæ. Isolated examinations have been made, here and there, and upon these we must base our estimates of the percentage of infection. The impression prevails in Germany, France, Italy, and elsewhere in Europe, that American hogs are more largely infected than those of any other country. This may be true as to certain parts of America; but is probably not true as to other parts. The percentage varies very much in different districts. I have collected the statistics of all examinations made in this country, and of American hogs examined elsewhere, so far as I have been able to find them.

Examination of American hogs, by the piece, in Prussia, shows an average of 4 per cent. infected. This does not show the absolute infection, for more than one piece may have been taken from the same hog. In Germany we find that of 170,382 hams examined 2,050 were trichinous; that of 60,341 sides examined, 551 were infected.

At other European points, where examinations were made of American meats, we find that of 332 sides examined, 2 were infected. Of 5,673 pieces examined, 47 were trichinous. That of 103,528 pieces examined in France, 2,080 contained trichinæ. (39.)

The following is a table of all the examinations of American meats that I have been able to find:

TABLE OF AMERICAN HOGS EXAMINED.

No. Examined.	No. Infected.	NAME OF EXAMINER.	PLACE.	WHERE REPORTED, ETC.
88	14	Prof. Müller . . . . .	Berlin . . . . .	Billings, 16.
400	(?) 00	Dr. Patton, 1881 . . . . .	. . . . .	Newspaper report.
1,328	28	Academy of Science . . . . .	. . . . .	B'n M. & S. Jour., v. 74, 136.
100	8	Belfield & Atwood . . . . .	Chicago . . . . .	13.
8,773	345	*Dr. F. S. Billings . . . . .	Boston . . . . .	16.
5,400	22	†Dr. J. T. Payne . . . . .	New Orleans . . . . .	209.
330	2	†Drs. Smith & Myers . . . . .	Texas . . . . .	237.
30	00	Dr. C. A. Simpson . . . . .	Georgia . . . . .	209, p. 138.
180	00	Prof. Stager . . . . .	Nashville . . . . .	209, p. 138.
200	00	Dr. Ames . . . . .	New Orleans . . . . .	209, p. 135.
28	00	Dr. Billings . . . . .	Boston . . . . .	16.
1,000	68	†Drs. G. & W. E. Sutton . . . . .	Indiana . . . . .	259, p. 123.
245	40	Drs. Harding & Rob'n . . . . .	Indiana . . . . .	259, p. 124.
200	13	Drs. Gatch & Miller . . . . .	Indiana . . . . .	259, p. 124.
610	29	T. B. Redding . . . . .	Indiana . . . . .	This report.
Unknown	Unknown	Dr. J. V. Stevenson . . . . .	Indiana . . . . .	259, p. 124.
60,341 sides	551	German Examiners . . . . .	. . . . .	See elsewhere, this report.
170,382 hams	2,050	German Examiners . . . . .	. . . . .	See elsewhere, this report.
103,528 pieces	2,080	French Examiners . . . . .	. . . . .	39.
392 sides	2	Europe'n Examiners . . . . .	Havre . . . . .	See elsewhere, this report.
5,673 pieces	47	Europe'n Examiners . . . . .	. . . . .	See elsewhere, this report.

[ See Addenda.]

Total whole hogs, 18,912; infected, 569.

Total pieces of hogs, 340,316; infected, 4,730.

Total Indiana hogs, 2,055; infected, 150.

\*All of these, except about fifty, came from Chicago. The rate of infection in 1879 was 1 to 17; in 1881, 1 to 28; in the fifty not from Chicago, 1 to 44.

† Most of this lot were Southern hogs. Eighteen of those infected were found in a lot of 520 received from St. Louis.

‡ Hogs killed at San Antonio, Texas, April to November, 1881.

Nearly one-third of all hogs examined in this country were from the South, and among them only twenty-four contained trichinæ, indicating that Southern hogs are but slightly affected, but this conclusion can not be safely adopted without more extensive observations.

From the foregoing tables and statistics it will be seen (excluding pieces) that 18,912 American hogs have been examined, of which 569, or a little more than 3 per cent. contained trichinae. If we include the pieces reported as examined at Havre in France, and elsewhere in Europe, counting two pieces to each hog, we shall have a total of 189,070 American hogs examined, of which 2,904, or nearly 1½ per cent. were infected.

In Indiana, Drs. George and Willis E. Sutton, of Aurora (259), report that they examined, during the fall and winter of 1874-5, more than 1,000 hogs, and found from 4 to 12 per cent. affected. The first 500 examined by them, contained forty-eight, or 9½ per cent. of infected hogs. If we assume that the other 500 examined by them, of which no record was kept, contained the lowest number of infected hogs, or only 4 per cent., we shall have 6½ per cent. of all the hogs examined by them infected.

Drs. Harding and Robbins, of Lawrenceburg (259), examined up to April, 1875, 245 hogs from that neighborhood, of which 40, or 16½ per cent., contained trichinae.

Drs. Gatch and Miller, of same place (259), examined 200 hogs, about same time, of which 13, or about 6 per cent., contained trichinae.

Others have, doubtless, made examinations, but I have not their figures.

I have examined 610 Indiana hogs, of which 29, or 4¾ per cent., were infected. Total Indiana hogs examined 2,055, of which 150, or over 7½ per cent., were infected. Examined at and near Lawrenceburg, 1,445, of which 121, or nearly 8½ per cent., were infected. None of those examined by me were from the neighborhood of Lawrenceburg. It appears, from this, that Lawrenceburg and vicinity is a center of high infection.

Total number of hogs examined in Europe (excluding those counted as American hogs, and excluding 3,164,360, in which definite numbers are not given), 5,184,360, of which 1,888 were infected, or one to 275, nearly. Of the 3,164,360 excluded above, from 1 to 9 per cent. of those indigenous to Germany, and 2 per cent. of those from America, were infected. I have no means of determining how many of these were from America.

Wherever examinations have been made trichinae have been found infecting men, hogs, cats, mice and rats. They have been found in Egypt, Palestine, Turkey, China, Russia, Germany, Sweden, France, England, America, and many other places, in the hog, both wild and domesticated. The few examinations made in this country, as well as those made in Europe, show that hogs fed in cities, in close pens where rats and mice abound, and where they are permitted to feed upon offal and the excreta of man and animals, are much more infected than those fed in open, clean places, such as fields, prairies, etc. Hence we must conclude that the opportunities for infection are fewest in sparsely settled districts, the open country, large and clean fields. Most of the examinations in this country have been made of animals from the great pork markets of the West, but it is probable that fully as many trichinae will be found in the hogs of the more populous East, where they are more often fed in pens in contact with rats, and often upon various kinds of offal.

#### SOURCES OF INFECTION.

From whence do hogs derive trichinae? This question has not been satisfactorily answered. Some claim that rats are the original source of infection; others, that man is responsible for the disease in the hog; others look to other sources for infection; but none of these theories have sufficient support to make them certain. Sufficient facts have not as yet been discovered to solve the question. It is certain



that hogs and rats often feed together, and that hogs eat dead rats, and that rats eat of the flesh of the hog; but it is just as likely the hog is the source of rat infection, as it is that the rat should be the source of hog infection. Probably they both act as infectants, not only to each other, but to their own species as well. (For a more exhaustive discussion of this subject, see 111.) Many examinations of rats have been made, showing as large or a larger per cent. of infection than is found in any other animal.

Gathering up all the statistics upon this subject, which I have been able to find among German, French, English and American reports, I find that of 2,748 rats examined 318 contained trichinæ, or more than 11 per cent.; that the per cent. is always largest where the rats examined came from the vicinity of large pork packing establishments. In Saxony 50 per cent. of the rats examined, received from the flayers, contained trichinæ, and 20 per cent. of all the rats caught in that country were infected.

The rat is very readily infected by feeding it with bits of infected hog meat, and affords a cheap and ready means for studying the parasite in all of its phases of development. The cat furnishes an equally favorable host and possesses some advantages from being larger and more easily managed. Cats are very numerous infected, especially in our pork-packing cities.

Any animal containing trichinæ may be the source of infection to any other animal susceptible of infection. This may take place either by receiving the females containing embryos, or the young living embryos, voided by animals infected, upon food taken into the stomach, or, possibly, from water in which they may have been voided, or from eating the flesh of dead animals containing encysted trichinæ; this last being the most usual method of infection.

Trichinæ adhere to the law, that every living thing is the offspring of a like living thing, as closely as do other animals, and, no doubt, began to be when the earth was made to bring forth the living creature, each after its kind, and it is not likely we shall ever know in what animal they first had a home. We can be certain, however, that if we, or our animals, do not receive the living trichinæ from some source outside of ourselves, through food or drink, there can be no infection.

#### TRICHINOSIS IN ANIMALS; SYMPTOMS, ETC.

A series of experiments were made by M. Chatin upon Guinea pigs and rats, by feeding them salted, trichinous American pork. He made a record of the symptoms and results. These may be found, in detail, in his work, "*La Trichine et Trichinose*," 1883, pp. 160 to 182. I can only summarize here. In the case of the Cobaye or Guinea pig he made seven experiments.

In the first experiment, diarrhea commenced on the fourth day, was severe on the fifth, and the discharges contained embryonic trichinæ; on the sixth day appetite nearly nothing, abundant diarrhea and embryos in discharges; seventh day, great prostration with continued diarrhea and embryos; death on the ninth day. In the second experiment, the diarrhea commenced on the fifth day after infection; this continued, increasing in severity, for ten days; general prostration on the fifteenth day, and death on the sixteenth; embryos in discharges from seventh day. In the third experiment, the diarrhea set in on the sixth day and death occurred on the nineteenth day, with similar intervening symptoms as before. In the fourth experiment intense diarrhea commenced on the second day after infection and the discharges contained numerous embryos. Death on the fourth day after infection. In the fifth experiment intense diarrhea commenced on the third

day and death followed the next day. Discharges contained embryos. In the sixth experiment diarrhea commenced on the fifth day, and death ensued on the eighth day. In the seventh experiment but little of the trichinous food was given to the animal at a time. Diarrhea set in on the eighth day, which continued six days; by the eleventh day recovered apparently. Gave a fresh supply of trichinous food on the twentieth day after first infection; diarrhea on sixth day, continuing four days. A third dose of trichinous food was given on the fifth day after the diarrhea had ceased. On the second day it manifested pain on motion; its motions were few and slight; it was stupid and evidently not well; on the third day, marked emaciation; on the fourth, abundant diarrhea; intense diarrhea on the fifth; death on the sixth day after the last infection. In these experiments the symptoms appeared early, or later, according as the dose was large or small.

In two experiments of repeated infections of rats, the average time from infection to the beginning of the diarrhea, was about six days. The average duration of the diarrhea was about five days. Five successive infections in one case, and six in the other, without producing death, establishes the remarkable resisting power of the rat. In these cases, upon killing the rats, their muscles were found filled with encysted trichine. But if the ingestion of trichinous flesh be large enough, or be followed up by rapidly succeeding ingestions, the rat can not resist. In some experiments, conducted by myself, the main features were the same as observed by M. Chatin, except that I gave the rats all the trichinous food they would eat, and death ensued in six to twelve days. M. Chatin records one death on the fifth day. I found, that where a large amount of the trichinous food was eaten by the rat, that diarrhea ensued in about sixty-five hours after the ingestion. I fed fresh meats that had not been salted.

The symptoms of trichinosis in hogs have never been thoroughly studied, so far as I am able to learn. A few experiments have been carried out, however, which may serve as a basis for a few remarks on symptoms in this animal. From the meagre information to be derived from the sources of information to which I have access, I conclude that the symptoms of trichinosis in the hog are usually less severe than in man. Probably, as a general rule, the infections are successive and light. In light cases but few and mild symptoms will be manifest and may escape notice entirely.

Gerlach ("Die Trichinosis," Hanover, 1873, p. 35 et seq.) says that pigs, from three to six months old, become infected more readily and completely than older animals. The symptoms, in light cases, consist of slight gastric disturbances appearing generally on the third and fourth days after infection, and in a few days these disappear. There is diminished appetite, lessened vivacity, drooping of the tail, and a tendency to constantly remain at rest. In severe cases, in five to seven days, there is a loss of appetite, diarrhea, vomiting, restlessness, loss of vivacity, hollowed back, drooping tail, posterior part of body stretched out, pawing with fore feet, fever, weakness, erection of bristles, paleness of skin, irregularly distributed and diminished temperature. The diarrhea continues six to eight days, or longer; in pigs death often intervenes during this stage.

The symptoms of muscular infection commence gradually from the eleventh to the twentieth day. They appear and increase in intensity as the intestinal symptoms abate: fever comes on; there is restlessness and an unsteady gait; the animal is stiff and tottering, irresolute and troubled. In very severe cases the animal will lie flat on its side with the fore legs stretched backwards, from which position rising is always difficult and requires help. The muscles about the mouth and throat become stiff; eating and swallowing are difficult; though appetite may prompt the



animal to feed, it turns away from its food; in some cases there may occur lockjaw; the lips and tongue move with difficulty; the animal dips his snout into liquid food in order to be able to swallow the little he can take. Difficulty of breathing is often present, as well as more or less wheezing and panting. The voice is greatly changed, and, in some cases, wholly lost; the eyes water at times; there is redness and swelling about the face; there is more or less emaciation, according to the severity of the case.

Where there is recovery, it usually takes place in about six weeks, but, as in man, there can never be a perfect recovery, but minor and modified symptoms will continue for months, if not during life. The trichina, in becoming encysted, act as so many centers of irritation, and as so many centers for abnormal, pathological changes in the animal's body during its remainder of life.

Many of the foregoing symptoms are common to hog cholera and other diseases, and, very likely, symptoms of trichinosis in hogs have often been attributed to other diseases.

Of twenty-three severe cases of trichinosis in hogs, produced by experimental infection, twelve died. The deaths occurred, two on the fourth day, and one each on the sixth, ninth, eleventh, fifteenth, sixteenth, seventeenth, nineteenth, thirty-fifth, forty-second and forty-ninth day after infecting. Of seventeen moderate cases, all recovered. (111, pp. 136-144, also 103 A.)

In moderate cases of trichinosis in hogs, there will be found in the muscles, after the migration is fully completed, from one to two trichina in each five microscopical sections of half an inch square. In severe cases we may expect to find from three to twenty in each preparation. A recovered hog may, therefore, have from six to forty thousand encysted trichina in every ounce of its voluntary muscles. Where hogs have survived and great numbers of trichina are found in their muscles, it is quite certain that they have received them at several successive ingestions of trichinous food. A single very large ingestion is almost sure to result in death.

It is claimed by most observers that young hogs are most easily infected. This is probably true, but so far as I have examined hogs for trichina, I have found them more frequently in old than in young animals. Dr. Sutton seems to have had the same experience (259). The several cases of fresh invasions observed by me were in animals ranging from ten months to two years of age.

Age does not seem to be a barrier to infection, either in man or animals. Another fact, well worth remembering, is that not only the flesh of animals that have had severe attacks of trichinosis is dangerous to man, but the flesh of those animals but slightly infected, in which the symptoms may have been quite inappreciable, is quite full enough of the parasites to fatally infect a human being who may eat a usual meal of it, in a raw or insufficiently cooked condition.

#### TRICHINOSIS IN MAN.

Prior to 1860, forty-nine cases of trichinosis in man had been observed and reported by twenty-eight different observers. (For list see 111, p. 11.)

Probably the oldest known epidemic of trichinosis is that reported by Fehr, (80 A.) which occurred at Würtemberg, in 1675, in which two persons died.

From various sources I have gathered the following statistics of cases of trichinosis in man, reported in Europe and other foreign countries, viz.:

Year.	No. of Cases.	No. of Deaths.
1860 . . . . .	65	1
1861 . . . . .	84	1
1862 . . . . .	791	28
1863 . . . . .	472	42
1864 . . . . .	437	10
1865 . . . . .	675	124
1866 . . . . .	127	5
1867 . . . . .	65	12
1868 . . . . .	5	4
1869 . . . . .	*	*
1870 . . . . .	92	*
1871 . . . . .	6	.
1872 . . . . .	28	1
1873 . . . . .	137	2
1874 . . . . .	207	2
1876 . . . . .	3	1
1877 . . . . .	164	9
Total. . . . .	3,044	231

\*Not reported.

A number of other cases and deaths in Europe, are reported elsewhere, but are not included in above list, because numbers are not definitely stated.

I find records of at least seven hundred and twenty-five other cases, with fifty-one deaths, in which dates are not given. There are also many reports of "*several*" and "*many*" cases, giving no date, and not stating number of deaths.

I find not less than 3,769 cases and 282 deaths. In many reports nothing is said as to whether there was a recovery. For tables embracing a portion of the above cases see 111, pp. 82-87. [See Addenda.]

#### CASES IN UNITED STATES

"A German family living in Davenport, Iowa, was affected with trichinosis in 1856. The mother returned to Germany and was admitted to the Alton hospital in 1861, where the resident physician extracted a cancer of the breast, in which Dr. Timm found numerous encysted trichinae." (Virch. Arch. Bd. XXX, p. 447.)

In 1864 the woman died and numerous living trichinae in calcified cysts were found in her muscles. (111, p. 172.)

This appears to be the first case, of which there is any certain knowledge, having its origin in this country, though Dr. Bowditch found trichinae in cadavers as early as 1841-2.

In 1864 there were nine cases reported in the city of New York, and one death. During the same year there were two cases in Cheektowaga, N. Y., both of which died. (Dr. Kronbein, Buf. Med. and Surg. Jour., June, 1864.) There were also at Marilla, N. Y., six cases, two resulting fatally. (Dr. Taylor, Am. Jour. Med. Sci., July-Sept., 1864.)

In 1865 seven cases were reported and others described, but no numbers given.

In 1866 there were nine cases at Lynn, Iowa, five of which terminated in death. (218.) There was also, during this year, an epidemic in Massachusetts, in which 17 per cent. of the victims died. (39, p. 133.)



In 1867 seven cases are reported, one in New York and six in Massachusetts, with one death. I find no record of any case in 1868. Two cases and one death are reported by Dr. Hunt, at Albany, N. Y., in 1869. (Trans. N. Y. State Med. Soc., 1869, p. 157.) In 1870 there were cases at Saxonville and Lowell, Mass., with one death; the number of cases not stated. For the same year, eight cases and three deaths are reported from Marengo, Dekalb county, Ill. (N. Y. Med. Jour., xi, 1870, p. 107.)

At Aurora, Ind., 1874, Dr. George Sutton reports ten cases, all from partaking of meat from the same hog. Three of the cases resulted fatally. (Trans. Ind. State Med. Soc., 1875, pp. 109-131.)

There were five cases reported in 1874, in Michigan, with two deaths. (Mich. Board Health Rep. 1875.)

An epidemic is reported in N. Y., 1878 by Joannes Chatin (39, p. 134), but he does not give his authority, nor state the number of persons affected.

In 1879 there were five cases and two deaths at Brooklyn, N. Y.; four cases at Martinville, N. J., and one death; five cases and three deaths at Milford, Ind., reported by S. P. Gilpin. (Am. Pract'r, Sept., 1879, p. 135.)

In 1880 there were four cases at Newark, N. J. Other cases are reported at Bridgeport, Conn., Newark, N. J., Baltimore and New York, but no dates nor particulars given. For tabulated lists of most of above cases, see 111, p. 172-3.

Chatin, in the work already cited, reports two epidemics in 1880 at Milwaukee and Chicago, with two deaths; also an epidemic in N. Y., in which a young man died. His muscles were filled with trichine. (39 D'Annales d'Hygiene et de Médecine Légale, 1881, p. 377.) M. Chatin also reports two epidemics, one at Ft. Wayne, Ind., and one at Marshall Min., with many victims in 1882, and in speaking of these two epidemics, says: "In America scarcely a week passes (?) that the journals do not register some fact similar to the following:"

"THE POISONED FAMILY—THE AGONY ENDURED BY THE JAEGER'S AT FT. WAYNE, IND.—[Official dispatch to the Evening Telegram.] FT. WAYNE, Feb. 9, 1882.—The News says with reference to the Jaeger family, five in number, who are suffering from trichine poisoning; they suffer intensely; no immediate danger is anticipated, but their ultimate recovery is doubtful. The girl, aged fifteen, and her sister, aged five, are in a very bad condition. No hopes are entertained of their recovery. The balance may survive. The oldest child was working in the country and came home to wait on the family, and eat once of the diseased meat. She has a very mild form of trichinosis."

The same author quotes, as follows, from a Minnesota paper:

"MARSHALL, MINN., Jan. 26, 1882.—Great excitement has been caused here by trichine poisoning from eating raw ham. Fifteen prominent citizens are afflicted and three have died." (39, p. 141.)

Dr. J. W. Edwards, of Mendota, Illinois, reports six cases of trichinosis, caused by eating pork not thoroughly cooked, four of which terminated fatally. (Am. Microscopical Monthly Journal, March, 1881, No. 59.)\*

M. Chatin, in the work cited, gives a list of ninety-one epidemics, most of them in Europe, during a period of twenty-three years. Among them he reports an epidemic at Dunkirk, U. S., in 1882, not included in above list, but no details are given.

There were three epidemics of trichinosis in Illinois in 1884—one at Gardner,

\*Since writing the above, two deaths from trichinosis, in 1884, and one, January 4, 1885, are reported at Bloomington, Illinois, and several other cases. (Indianapolis Journal, January 13, 1885.)

one at Woodburn, and one at Bloomington. The number of cases are not reported, but the quarterly meeting of the Illinois State Board of Health, last spring, reported three deaths. ("The Microscope," April, 1884, p. 92.)

In the latter part of 1883 quite a severe epidemic of trichinosis occurred in Ermsleben, a village in Saxony, in which over two hundred persons were affected, including all the members of one hundred and thirty-four families, except fifty, and of whom eighteen died. (*La Gazette Med. de Paris* and *The Microscope*, January, 1884, p. 22.)

In addition to the cases above reported, occurring in Europe, M. Chatin reports for 1878 to 1882 eighteen additional epidemics; among them, one of one hundred and fifty cases; another of one hundred and fifty to two hundred cases, and many deaths, though the number is not stated. (39, pp. 134-140.)

The same author also gives a list of seventeen epidemics at various points in Europe, prior to 1878, none of which are included in any of the above lists. (39, pp. 130-134.) He also reports an epidemic in 1880, which is also reported in Virchow's Archives, vol. 83, p. 553, at El Huleh, on the Jordan, in which two hundred and sixty-two persons contracted the disease, from eating of the flesh of a wild hog, which had been shot in the swamps adjoining the village. In this epidemic one hundred and twenty-four males and one hundred and three females and thirty-five children were affected. Of these, three males and three females died. This is the first case reported from the Orient. (39, p. 139.) [See Addenda.]

The foregoing lists are doubtless very imperfect, and probably embrace only a few of the cases occurring in Europe, as well as in this country. No doubt a great many cases of trichinosis occur which are treated as cases of diarrhea, dysentery, gastric enteritis, typhoid fever, etc., the symptoms of these diseases often having much in common with those of trichinosis.

Dr. Glazier collected statistics of trichinae found in the human cadaver, in numerous medical colleges of our country, and gives thirty-six cases in which trichinae were found. (111.) He also received quite a number of reports showing that trichinae are frequently found in cadavers, but no record of them was kept. In most autopsies no examinations are made for trichinae.

Delpêche says: "Wagner assured us that he had met trichinized corpses in the proportion of four to six per hundred." (Leuckart.)

"In many cities of Germany, Dresden, Berlin, etc., the number of trichinized corpses is as high as three per cent."

In nearly all the large cities of Europe, in which examinations for trichinae have been made, in the dissecting-room, they have been found in from one to six per cent. of the corpses examined, if we may judge from the vague reports we have upon that subject.

Taking the above reports, where numbers are given, we have a total of more than one hundred and nine cases in the United States, with a total of forty-one deaths, but the actual number of cases in our country is probably twice as great. Many cases are probably never reported, and, when reported, the reports are so scattered that it is almost impossible to collect them.

The fact that diarrheal, dysenteric and choleraic symptoms are so uniformly present in all severe cases of trichinosis, especially in its earlier stages, and the fact that so many unexplained epidemics of the various forms of diarrhea occur, especially among the poor and foreign residents of our large cities, who either eat raw pork or are careless about its thorough cooking, furnishes sufficient grounds for a grave suspicion that many of these epidemics are due to trichinosis.



## MISTAKEN FOR OTHER DISEASES.

Trichinosis has often been mistaken for other diseases, such as typhus fever, typhoid fever, gout, influenza, rheumatism, oedema of the muscles, gastro-rheumatic fever, catarrh, "sweating fever," "acrodynia," cholera, diarrhea, and dysentery. Such mistakes have been clearly demonstrated in many cases. (Consult 230, 128, 243, 143, 289, 59A, 259, 196, 1A, 195A, 142, 103, 204 A, 220.)

## SYMPTOMS.

The symptoms and effects produced by trichinae in the human system may be divided into two classes, muscular and intestinal, according to the locality of the parasite at the time of the occurrence of the symptoms.

Food containing larval trichinae, taken into the stomach, is acted upon by the gastric and other fluids so as to dissolve the cysts containing the worms and thereby setting them free, and, as elsewhere shown, these trichinae, thus set free, rapidly develop and become sexually perfect within about two days after they enter the stomach. The females, soon thereafter, give birth to large numbers of embryo trichinae, which being set free in the intestines produce the intestinal symptoms, probably assisted by the adults. These minute embryos exist in vast numbers. Cobbold estimates that the ingestion of one pound of trichinous flesh will give rise to as many as four hundred million young trichinae. Leuckart thinks the number would be greater.

The symptoms and effects will vary with the number of the trichinae received into the stomach, the susceptibility of the individual and the period elapsing prior to the onset of the disease. (244.) There may be many small ingestions before any serious difficulty may be experienced, for trichinosis is preëminently a cumulative disease, each successive ingestion, however long apart, adding to those already in the system, and many cases, owing to these successive small ingestions, will be slow in their progress and may be classed as insidious, or masked cases, producing but little alarm at the time.

"Those suffering from the insidious form may be able to walk about, but feel tired and exhausted; they may have a good appetite, pulse be normal, or nearly so, the evacuations normal, or but little changed;" the sleep may be but little disturbed, but such affected person will experience drawing or lancinating pains here and there, especially in the nape of the neck and extremities, with or without rigidity of the deeper muscles. "They are neither sick nor well, yet feel something of which they can give no account."

If there be no fresh invasions the patient soon gets nearly well; but if there be new invasions a severer form of the disease will be experienced. In many mild cases there will be nearly all the symptoms of chronic rheumatism.

In cases where the invasions have been large the symptoms will be much more severe.

"From a few hours to a few days after the ingestion of the trichinous flesh, the patient is seized with symptoms of indigestion; complains of nausea, cardialgia, belching, diminished appetite, the tongue is coated, there is a fetid breath, vomiting, or eructations, a feeling of general weakness and prostration and utter exhaustion; there are flashes of heat, rigors, fullness of the frontal region, vertigo, lancinating and flying pains in a few groups of muscles, particularly in the nape of the neck and flexors of the extremities."

"After two or three days there appears a choleraic or diarrhealic discharge from

the bowels. The vomited matter is first slimy, then bilious. The stools, at first brownish and streaked, take on the clay-like character of many typhus stools. Severe neuralgic pain is almost always present in the abdomen, and pain is felt in the arms and legs and sometimes in the intestines." (220 and 111.)

"In the severest cases the patient may suddenly die at this stage of the disease with all the appearances of cholera, or from extreme exhaustion." Those who do not vomit now and then, become by degrees excessively debilitated. (111.)

A common complaint is that of feeling so tired. (259, 142, 230, and others.)

In some cases, probably in most, there are headache, pain, soreness, swelling of the lips and tongue, and often the earlier symptoms are so severe as to cause a strong suspicion of poisoning to be entertained.

The foregoing symptoms last about eight days. The second stage of the disease usually commences about the ninth or tenth day. The most constant and distinguishing symptoms of the second stage are oedema, swelling, and profuse perspiration; the skin is covered with sweat which is acid, persistent, abundant and often of a nauseating order. (142, p. 74.) The eye-lids, lips and other parts of the face swell more or less; the pupils may be dilated, and there is sometimes an intolerance of light. (220.) The muscles of the eye are often among the earliest to be attacked by the trichina, which probably accounts for the diminished accommodation and fixedness of the eye in many cases. "Pain in the orbital muscles, often occurring in the fifth or sixth week, especially in the morning, is present in all severe cases." (111.)

The fever increases suddenly (142); the pulse runs from 80 to 120 per minute, or more; great thirst and a feeling of intense heat afflicts the patient; "the tongue is furred, yellowish white, or covered with a black, sooty, clammy coating, soon losing all epithelium, becomes of a uniform, dark brownish red." (111.) "Suddenly, generally in the night, there occurs extreme dyspnoea (difficulty of breathing), often lasting for several hours, and sometimes recurring daily for weeks; sometimes the diaphragm sinks down and remains in a state of tetanic rigidity." (111, p. 98.)

The mind is usually clear to the last, but "there is a total indifference to surroundings, but great fear of death." (111.) There is sleeplessness in adults, not in children; colic and mesenteric neuralgia; hyperesthesia of the skin; sometimes a feeling as if insects were crawling over the person (formication); occasionally swelling of the lower limbs; hearing is often impaired (181); the muscles of the neck, loins and limbs become stiff and tender; motion is very painful; "the elbows are bent and the knees are drawn up; the patient rests best upon his back; the tongue becomes stiff; there is a difficulty in swallowing; there is hoarseness, asthmatic cough and arrested stools. In short, all the appearances of a fatal case of typhus fever are presented." Pressure upon the surface leaves no marks, or if any, they are quickly effaced. The skin changes frequently in temperature, and often breaks out in perspiration.

In a very large number of cases there are lung and pleural complications, verified in many cases by post-mortem examinations. "The muscles of the larynx are notoriously infiltrated with trichinae." There is often extreme bronchial catarrh and inflammatory processes of the lung and pleura. Of seven fatal cases examined by Ruprecht, pneumonia existed in six. Virchow says: "In a few cases I

ve examined the bodies of those said to have died of consumption, and found, besides marked lung disease, extensive trichinization and extreme emaciation." Looking at these facts, may we not justly suspicion that many cases of chronic lung diseases have had their origin in slight attacks of trichinosis?



Many other symptoms are found in different cases, and may be studied in medical and other works, such as those of Kratz, Leuckart, Chatin, Meisner, Kestner, Clazier, and others referred to in the bibliography. I also take pleasure in calling special attention to the article of Dr. George Sutton, of Indiana, on this subject, in "Transactions of Indiana State Medical Society," 1875, pp. 109-131.

In cases of recovery there is a gradual subsidence of the more intense symptoms, but perfect recovery is probably impossible. The parasites become encysted and permanent guests of their hosts, and in time their cysts become more or less calcified, as elsewhere shown, so that the person must ever carry, scattered thickly through all the voluntary muscles, a large number of these abnormal bodies, which can not do less than maintain a low grade of irritation, and there will remain constantly recurring slight pains, soreness, weariness and lassitude. In some cases there will be continued emaciation, but the tendency will be toward obesity from the fatty degeneration incident to the presence of the cysts and the contained trichinae for a long period of time. The trichina comes to stay with us during life, and, even if it dies, it leaves us as a legacy, its old, calcified, stony dwelling. If it once finds a lodgment in our muscles, there is no remedy, nor means for expelling it. It lives on, coiled up in our muscles, it may be from ten to twenty years, or even longer. "As long as the trichina remains in the muscle and occupies his cyst his condition remains unchanged." (168, sec. 546.) In most cases where trichinae have been found encysted, they were alive. The only time when remedies can expel trichinae from the human body, is while they remain in the stomach and intestines. "We have heard of cases of living trichinae where the patient had been attacked eight, thirteen and a half, and even eighteen years previously." (163, Note p. 62.) Danman reports encysted living trichinae eleven years and three months after infection. (63.)

Trichinae also retain their vitality a considerable length of time after the flesh containing them becomes putrid. Dr. Sutton says: "A week after Mrs. Beater had been buried the flesh, when examined with the microscope, was found to be filled with trichinae, most of which, when a strong light was thrown upon them, showed evidences of motion." (259, p. 121.)

The Vienna committee of 1867, say: "After remaining for months in putrid flesh they did not lose their vitality." (186, A.) Goujon infected other animals with trichinous flesh, eighty to one hundred days after it became putrid. (108.) Klepsch reports trichinae alive after twenty-five years. I think it probable that in most cases encysted trichinae perish in the course of ten to fifteen years, when the cysts have become thoroughly calcified. Sufficient experiments have not been made to demonstrate with any degree of certainty, the ultimate limit of their vitality. I have kept trichinous pork in water forty days and then examined it under the microscope, and found the encysted trichinae alive and apparently unharmed by the prolonged maceration. This was, however, in the winter time, in my office, and there was not a complete decomposition of the flesh. It was kept in a bottle filled with water, at the usual temperature of the office.

#### TREATMENT—REMEDIES.

"At the present time the treatment of trichinosis does not afford a hopeful outlook." (Heller, 116, p. 642.)

"The therapeutics of trichinosis deserves no great praise. Means by which the muscle or intestinal trichinae can be destroyed, have not, after the most careful search, been found." (Falck.)

Delpech says (68, p. 102.): "It may be said that there are no medical preventatives which protect against trichinosis, when trichinous meat has been eaten. Anything thus recommended is based upon charlatanism or personal illusion. It may be that in a great many cases such and such a remedy might apparently have prevented the development of the disease, or rendered it insignificant. In such cases the meat has contained but few trichine, or the subject had a strong constitution. If there is a substance that will kill the parasites in the stomach or intestines, it has not yet been found. If such an agent can be found, of which there can be no doubt, it certainly will not be an ordinary remedy, as wine or brandy, spices, etc., but a true medical substance. Such a remedy can never be used as a prophylactic."

It is agreed by all authorities of any considerable experience that there is no certain remedy for this terrible disease, in any of its phases. The only time at which medication can be used with any hope of success, is while the parasites and their embryos are in the stomach and intestines.

Many remedies have been suggested which have apparently been efficacious in some cases, but have proved wholly useless in others. It is very probable that where they have appeared to be of any value, that the attack was comparatively light; or that the remedy was administered at such time as to expel the trichine from the bowels.

The trichina has great resisting powers, not only against heat and cold, but also against most insecticides, germicides, etc.

Dr. Geo. T. Angell, of Boston, recommends the use of sulphur. (39, p. 144, note.)

Several persons recommend alcohol during the first few hours of the invasion; others condemn its use.

Benzine, picronitrate of potassa and of soda, glycerine, sulphocarbolate of soda, calomel and mercury in its various forms, morphia and ergotine, salicylic acid, iron, heat, cold and electricity, turpentine, salts of lime, santonine, and a great number of drugs and chemicals have been recommended by some and condemned by others.

Trichinosis is, therefore, a disease to be most carefully guarded against by the observance of proper sanitation and hygiene, rather than cured by remedial agents. Prevention is the only safety.

#### INSPECTION.

Inspection of our hog meats is a necessity for several reasons. It is necessary in order to refute false and interested representations made by certain foreign inspectors who represent American pork to be worse infected than it is in fact. For example:—A published document from the Minister of the Interior in Neuchâtel asserts that the microscope had shown *more than half of the American hams and canned meats to be infected*. This assertion nearly destroyed the trade in American meats in that canton, where it had before been quite large.

Many cases of exaggeration and misrepresentation might be quoted to show how our trade is injured by false reports, which an inspection at home, before shipment, would furnish ready evidence to contradict. But there is misrepresentation on both sides of the question. It is astounding that public men will deliberately publish to the world that "there is no established case of American hams being infected with trichinae." (Fleming's Vet. Jour., June, 1881, p. 462.) The evidence, unfortunately, is overwhelming to the contrary.

John M. Wilson, our Consul at Hamburg, June 3, 1879, writes: "A rigid and thorough microscopic inspection is now made in all parts of Germany by govern-



ment inspectors of hams, pork, etc., exposed or intended for sale, and if in the least infected the same is confiscated." He also calls the attention of our merchants and business men to the importance and the necessity of sending none but the best, and to be certain that the same is not infected, and says, that a thorough inspection of our meats before shipping would "in a great measure *enhance the value of our products, increase our trade and do away with the general distrust now prevailing in Europe against American meats.*" (111.)

Edward M. Smith, U. S. Consul at Manheim, says, that for want of inspection and on account of trichinae in our meats, "German pork sells here for eighty pfgs. to one hundred and thirty marks; American pork sells for thirty pfgs. to sixty-five marks." This discrimination was made against American pork because two and one-half per cent. of the pork shipped there was infected with trichinae. Certainly home inspection, that would have thrown out this two and one-half per cent. of infected meats, would have resulted in a very handsome profit.

Every exclusion of American pork from foreign markets, every discrimination against American meats, is a solid money argument in favor of home inspection and such regulations as shall prevent the exportation of diseased meats. If one or two per cent. of our exported meats be diseased it lowers the price of all and involves all in a common suspicion, and often wholly prevents its sale, producing heavy losses.

Mr. Mason, our Consul at Basle, says, in substance, that the foreign trade in salted meats can never be fully restored without establishing in this country a system of official inspection which shall carry with it the weight of State or Federal authority. (124, p. 161.)

Inspection is a necessity to prevent the use of diseased meats among our own people, and to prevent infection with trichinae, when such meats are used raw, or insufficiently cooked. There can be no assurance that our pork, in the multitudinous forms in which it is presented to us, is always sufficiently cooked to destroy all the parasites, at least not while cooks remain fallible.

If pork be cooked, but underdone, there is danger of infection. "So that cooking is no guaranty that the trichinae are all dead" Falek (100, p. 520) says: "The best way is not to eat pork; but if you must eat it, do not eat raw pork."

If meats be thoroughly cooked to the bone, all the trichinae it may contain will be killed, and trichinosis can not result from its use.

As has been shown elsewhere, trichinae in the hog produce diarrhea, fever and other disturbances characteristic of disease. The inflammation continues during encystment, and for a long time afterwards, gradually diminishing. It is thought by some that the cysts contain not only the worm, or larval trichina, but also a certain specific poison, the product of the pathological changes incident to the presence of the parasite. Looking at the matter in the most favorable light possible, we must allow that wherever trichinae exist in the hog, it is a diseased animal and not in perfect health. Every cyst is as much an abnormal formation as a cancer, tumor or other malformation in the animal system, though quite small.

Are such meats healthy, even though the worms it contains be killed by heat? Is it prudent, or in accord with an enlightened taste to use such food under any circumstances, when it is so easy to avoid its use? The ultimate effects of such food have not been determined, but surely the cultured mind and taste will rebel against partaking of the flesh of animals thus diseased.

It has been asserted that thorough salting of meats will kill trichinae, but this is a mistake. It may hasten their death somewhat, but it is certain that they will live in thoroughly salted meats several years at least. Would a thoroughly salted

animal, full of minute tumors and cancerous formations, be rendered palatable and desirable food through the saving influence of salt? It has been demonstrated by experiment that when trichinous flesh has been salted with all the salt it could be made to take, and kept buried in salt for more than a year, the parasite still remained alive and capable of developing sexually, propagating its species, and of producing infection in other animals. (39, pp. 184 to 190.)

Smoking is, also, ineffectual to kill them. Thoroughly smoked, salted and dried meats containing the parasite, have, when fed to animals, produced infection quite as readily as fresh meats. The parasite, when encysted, is in a dormant larval state and does not devour the tissues in which it is entombed. It lies there, coiled up, motionless and apparently lifeless, awaiting the time when it shall enter the stomach of some animal suitable to its development, and there awaken into a new and perfect life. This fact has led some into error, and they have imagined that because they see no motion and no signs of life in the encysted worm, that, therefore, it is dead.

In the *Scientific American*, as quoted by "The Microscope," August, 1883, vol. III, p. 124, John Wilson, Consul at Brussels, is quoted as follows: "I have myself been present when officially appointed microscopists at some of the abattoirs of this country have been engaged in examining American pork for trichinae, and I have been invited by these gentlemen to see for myself, through their microscopes, the peculiar cell and spiral coil of the animal; but on carefully examining them, I have only observed, blended with the tissue and minute salt crystals, the entombed animal, evidently as destitute of life as the structure in which it was embedded."

"It is claimed by most trichinic observers that the process of generation and birth of this little animal invariably takes place in the stomach and intestinal canal, and that within a few days from its birth it has so matured as to penetrate the walls of the intestines and rapidly make its way through the various intervening structures to the remote muscular tissue, etc. \* \* \* Of this theory of the life and movements of this little worm I can only say that it involves an almost unparalleled exception to the law generally regarded as determining animal life. \* \* \* The law governing parasitic existence in living tissue usually involves the speedy death of the parasite after the pabulum upon which it feeds has passed from under the domain of vital force, etc."

And then he adds that he has scarcely a doubt but that salt kills the trichinae, and therefore concludes that foreign governments are at fault for excluding our pork.

The Consul may be a very intelligent man, but certainly is not versed in the life history of the trichina, nor acquainted with the many observations and experiments in this direction, and shows an ignorance on the subject that is unfortunate, as his position gives him the weight of authority. The larval trichina is no more killed by the death of its host than is the pupa of the moth or butterfly killed by the fall and decay of the leaves of the tree upon which it may have spun and fastened its cocoon; nor does it devour its host, as food, in this dormant state, any more than the pupa of the butterfly devours the tree upon which its silken cradle is fastened. The several steps of the life history in the progress from the larval trichina to the perfect sexual worm, the fecundation of the ovules, their development, the birth of the young embryos, their migration to the muscular tissue, their encystment therein, their long continued vitality, and their power, after years of this entombed state, to reproduce the cycle of their existence is not theory, but demonstrated fact.



Leuckart, who has made many examinations, and is considered good authority upon this subject, says (163, p. 91): "It has been clearly demonstrated that trichinae possess a very unusual power of resistance. Not only may they remain alive in their cyst for many years, and during putrefaction of the meat containing them, but they show a high state of indifference to the effects of changes of temperature."

The use of infected and diseased meats can only be guarded against by thorough microscopic examination of all meats offered for sale, as well as that provided for private use. An ordinarily intelligent person can readily learn to detect the presence of the encysted trichinae within a few hours. A microscope suitable for the purpose can be bought for \$20 to \$30, or the trichinoscope of "The Bausch & Lomb Optical Co.," of Rochester, N. Y., costing about three dollars, will show the encysted parasites quite readily. Of course, a good microscope is better and safest. The discovery of fresh invasions, while the parasite is in its embryonic form, will require more skill and better instruments. A power of forty diameters is quite sufficient for the detection of the encysted worm, but a much higher power will be required for a thorough examination and study of the parasite in all of its varied forms.

#### PREVENTION OF INFECTION.

"Trichinae belong to that dangerous class of parasites which always increase in numbers, and thus afford increasing dangers, unless all possible means are used against them." (Gerlach.)

"The microscopical examination of hogs, after killing, in connection with other means of protection, is always a necessity, especially in all places where trichinae have been previously found. The experience of ten years proves its usefulness, its security, and the possibility of its execution. \* \* \* No measure for the protection of the public health can show a more brilliant success." (Gerlach, "Die Fleischkost," pp. 69, 70.) Professor Gerlach is high authority.

In order to prevent the dissemination and increase of trichinosis among our hogs, it is necessary for our people to know what trichinae are, their life-history, modes of propagation and dissemination, and the centers of infection. It is the business of State and other Boards of Health, aided by proper legislative action, to furnish the people this information, and to secure to them proper protection. To ascertain where the centers of infection are, the extent and causes of infection, as far as possible, there should be a regular, systematic examination of every hog killed for sale in our markets, for export or for private use, and reports made thereof to the proper officers. Rats should be exterminated as far as possible, and examined as to their share in the work of infection. Hogs should be fattened as early in the season as practicable upon clover fields or in open, clean places, away from buildings and rat harbors. All animals dying among them should be at once removed, and in no case should hogs be allowed to feed upon dead animals of any kind. The purity of the water to which they have access should be guarded with the utmost care, and especially should the water be kept free from all dead animals. Under no circumstances should hogs be fed upon the offal of slaughtered animals, or upon animal food of any kind, nor should they be allowed access to human excreta. No drains should flow from houses and water closets into the enclosures where hogs are fed. Feeding should be so managed as to prevent the food being contaminated by the excreta of the animals. There should be frequent changes to clean places. Close, small and dirty pens and enclosures should be avoided. All hogs suffering from diarrhea, at any time, should be singly isolated from all the others, and the discharges examined for trichinae.

All sick hogs should be thus isolated. Stalls, stables, pens, or other close quarters where hogs are kept, should be often and thoroughly cleansed.

By use of proper instruments, suspected living hogs may have bits of their muscles submitted to microscopical examination without doing the animal any serious harm. No infected hog should, under any circumstances, be used as human food. It may be used for other purposes, not quite so valuable, which will prevent a total loss.

Let every one understand and be governed by the fact that clean food, pure water, clean places for feeding, and the total prohibition of animal food to our pigs will give us healthy, non-infected pork. One trichinous hog may, and probably will, infect all of its companions, more or less, if fed with them any length of time.

There should be a rigid supervision of all slaughter-houses, and the washings and offal from such places should never be allowed to reach the water that hogs drink or the places where they feed. As has been stated elsewhere, trichine will remain alive in putrid flesh, and in flesh immersed in water a month or more, and still be capable of imparting infection.

Such rules as these, properly enforced, would, in all probability, soon rid our country of this dangerous parasite, or at least reduce the infection to a very low per cent.

#### ADDENDA.

Since writing the foregoing report a number of facts have come to my knowledge, which I embrace in this addenda.

Over forty additional cases of trichinosis in the United States have come to my knowledge, of which ten persons died, making total number of known cases in the United States 149, of which 51 died. Half of these additional cases are from Michigan.

In the first annual report of the Bureau of Animal Industry of the United States, 1884, Dr. Salmon, in an article entitled "Trichiniasis," gives an account of a number of these new cases. He also reports 3,331 hogs examined from August to December, 1883, at Chicago, by Dr. Detmers for the Department of Agriculture, of which 80, or 2.4 per cent. were infected. Of this number 1,126 were from various unknown regions of the West, of which 4.08 per cent. were infected; from Michigan 50, 4 infected; from Iowa 831, 19, or 2.27 per cent. infected; from Illinois 520, 7, or 1.35 per cent. infected; from Dakota 50, 1 infected; from Wisconsin 304, 2 infected; from Nebraska 350, 1 infected; from Minnesota 100, none infected. Examined at the laboratory of the Department at Washington 300, in 1884, of which 5, or 1.66 per cent. were infected. Examined by Drs. Osler and Clement, at Montreal, Canada, 1883, 1,000, of which 4 were infected.

The above are the only examinations of American hogs coming to my knowledge, and not given in my report. These do not materially change the estimates made before, but tend to confirm them. Adding the above to the total of American hogs examined in this country we have a total of 22,543, of which 2.85 per cent. were infected. Dr. Salmon, taking all home and foreign examinations, and counting foreign examinations of pieces each as a distinct hog, estimates a total examination of 298,782 hogs, of which 6,260, or 2.1 per cent. were infected. My estimates, counting two pieces as from one animal, somewhat reduces this per cent., but it is probable that the average per cent. will be found very near or quite 2 per cent for the whole of the United States.



The United States commission of inquest upon the subject of trichinæ, etc. (236 B), appointed July 30, 1883, composed of Hon. Geo. B. Loring and others, estimate the infection at 2 per cent. I made my estimates before I had any knowledge of theirs, from statistics herein given.

This commission are represented by Dr. Santa, (236 B, p. 19,) as charging foreign inspectors, especially 18,581 German experts, as notoriously incompetent, and as furnished with poor instruments. Much unfairness and misrepresentation have been charged upon foreign experts and microscopical examiners of infected American pork, by many American writers, but the figures and facts given in this report show that a greater per cent. of infected animals have been found among the 22,543 hogs examined by American experts at home, than among the more than 275,000 American hogs examined by German, French, and other foreign experts; and if we take all foreign examinations of hogs from all quarters, amounting to nearly nine million head, the per cent. is still slightly below that found by our own experts among American hogs. These facts and results, I think, do not justify the criticisms made, but tend to show that the examinations, both at home and abroad, have been, usually, fair, honest and reliable, and have been honestly reported. Our own figures make a slightly worse showing for us than do those of foreigners. Probably, in some isolated cases gross misrepresentations have been made, and it is not at all improbable that some of the examinations have been made and reported, both at home and abroad, by very incompetent persons, using very poor instruments and appliances. But scientific men are usually very careful to give the exact truth in reporting observations as they appear to them.

During 1884 the "French Society of Hygiene" published a pamphlet, prepared by Dr. Prosper de Pietra Santa, General Secretary, entitled "Trichine et Trichinose aux Etats-unis," based upon a series of documents, official and private, from parties in this country: and, as I feel sure there is some misunderstanding, either on the part of those translating the letters into French or the writers, and that facts are not correctly stated, I take the liberty of giving parts of the correspondence, and the statements made, so that the truth may be known, which the importance and official character of the work, I think, clearly demands. That my translations, which are free, may be subject to the criticism of any one understanding the French, I give parts of the French text.

Through Dr. Santa, M. Colin D'Alfort requested samples of trichinous pork to be sent him from this country, in order to make a series of experiments upon animals. On March 6, 1884, Dr. Santa wrote to Dr. Billings, of Washington, G. P. Brown, editor of *Sanitary News*, of Chicago, and Howard Young, of Hartford, Conn., asking for such specimens.

Dr. Billings answered, March 25, 1884, that he could not procure the specimens at Washington, but wrote the Health Officer of Chicago asking him to supply the desired specimens.

G. P. Brown answered, March 24, 1884, "It is just now absolutely impossible to secure any specimens of pork infected with trichinæ." \* \* \* "J'ajoute que la plus importante maison d'ici faisant le Commerce des Viandes de porc (tueries, emballage pour l'exportation, préparations pour la consommation indigène), tient à son service un micrographe proposé à l'examen minutieux des viandes au moment de l'abatage et de l'embarquement. Cet employé m'a assuré que, pendant ces six derniers mois, dans ses recherches journalières, il n'avait pas trouvé un seul exemple de trichine," which I render freely as follows: "I may add that the most important house here dealing in pork (killing, packing, exportation, preparations for home consumption) keeps in its service a microscopist charged with the minute

examination of meats at the time of the killing and of the shipment. This employe has assured me that during the last six months, in his daily researches, he had not found a single example of trichinæ." (236B, p. 6.) •

Dr. DeWolf wrote an answer to Dr. Billings, which was forwarded to Dr. Santa, and is given in the French, as follows, so far as it relates to the point under consideration: "Nous avons ici, dans la maison Armour, un employé préposé à la recherche de la trichine dans les viandes de pore (hunting) (chassant) for the parasite. Il y a deux ans, ses constatations de trichine étaient fréquentes (come plenty), mais dans ces derniers temps, il n' a pas recontré un seul echantillon (a simple specimen)." Which I translate as follows: "We have here, in the house of Armour, an employce charged with searching for trichinæ in pork. For two years his findings of trichinæ were frequent, but of late he has not met a single specimen." (p. 7.)

Upon receiving and examining the pamphlet of Dr. Santa, and the letters quoted above, I wrote Mr. G. P. Brown and Dr. DeWolf, sending a list of questions, with a request for an answer, with a view to getting material for my report. Mr. Brown answered very kindly as follows:

"CHICAGO, March 12, 1885.

"T. B. Redding:

"DEAR SIR—The delay in answering yours of February 17th, categorically, has been due to lack of time to attend to the investigation desired. Until within the past four months, at least for a year and a half, a specialist was employed at the packing house of Phil. Armour, the largest in the country, but as he was unable to find any evidences of trichinæ, at least to any extent worthy of attention, his services were discontinued, and no one is now employed for that purpose, either at Armour's or any other packing house in this city. The microscopist to whom I refer was Prof. P. B. Rose, formerly of Michigan University, Ann Arbor, Mich., who could be reached, probably, by addressing him there should you desire any further information. The information I give you was obtained from Mr. Cuthay, superintendent of Armour's establishment. Dr. Detmers, United States Government Inspector, made an examination for trichinæ four months ago. He examined 2,000 hogs from the loin to the bone. Out of this number one hog only was rejected for trichinæ; the microscopical instrument used not known. As already stated, no regular inspectors are now employed. The expense was not kept as a separate item, hence no figures could be given, other than you could estimate yourself. The examinations are made when the hog has been prepared for cutting up, either for packing or for the market. Different portions of the flesh are cut into slices, taken, pressed out and examined between two glasses, as in ordinary microscopical work." As trichine were not found, of course the information must necessarily be rather negative. Trusting this will be satisfactory, I am,

"Yours truly,

G. P. BROWN."

I wrote Prof. Rose, at Ann Arbor, but received no answer. I also wrote Messrs. Armour & Co., asking questions to elicit full information, to be used in my report, and received the following answer:

"CHICAGO, March 14, 1885.

"T. B. Redding, Esq., Newcastle, Ind.:

"DEAR SIR—Replying to your mail favor, 13th inst., would say that you have been misinformed. We do not employ a 'microscopist,' and can not answer your several questions.

Yours very truly,

"ARMOUR & Co. D."

I wrote them again, giving the substance of the letters of Mr. Brown and Dr. DeWolfe, as above quoted, and requested an answer to my former questions, to which I received the following reply

"CHICAGO, March 17, 1885.

"DEAR SIR—We have your favor of the 15th inst., and its contents have our very careful attention. About a year ago there was a gentleman, Mr. H. Detmers by name, who was employed by the Commissioner of Agriculture, the Hon. G. B. Loring, to conduct some investigations here and elsewhere concerning the diseases of cattle, hogs and other animals. He visited our establishment several times, and we, of course, extended him every facility in our power, in order that he might make an intelligent report to the government. That report can doubtless be obtained by application to the proper authorities at Washington. We have never, ourselves, employed a chemist for that purpose, and consequently your information is entirely wrong. It doubtless arose, however, from the circumstances we have mentioned. We are unable to answer definitely the several questions you propound, although we are sure that the result of the investigations mentioned was that the percentage of trichine found was infinitesimal. We remain,

"Very respectfully yours,

"ARMOUR & Co."

In reply to my letter to Dr. DeWolf he answered as follows:

"CHICAGO, March, 28, 1885.

"DEAR SIR—Your letter of 19th was received during my absence from the city, and has awaited my return for reply. Armour's house has always been selected as the point from which to obtain specimens for examination, from the fact that all varieties of hogs were found there and in great numbers.

"Examinations previous to 1883 showed about 8 per cent. of hogs infected, but subsequently an infected specimen was difficult to find. Our chemist, Dr. Paton, (not now with us) found no trichine in 1884 although he made daily examinations up to June of that year.

Respectfully, yours,

"OSCAR C. DEWOLF."

In a subsequent letter Dr. DeWolf referred me to Dr. Detmer's report, noticed elsewhere.

On the 30th of March, 1885, I wrote Dr. Paton requesting him to give me the number of hogs examined, methods, etc., but he declined to do so without a fee, and as the State Board had not supplied me with funds for that purpose, I could not comply with his request, and am without the desired information.

The work of Dr. Santa, above referred to, after giving the letters and other matter, contains a synopsis of a report of the following commission, appointed by the President of the United States July 30, 1883, viz: Geo. B. Loring, E. W. Blatchford, C. E. Chandler, F. D. Curtis and D. E. Salmon. From this synopsis, of that report, I make the following quotations and translations:

"Sanitary condition. Tous les fermiers Américains savent aujourd'hui que les cochons sont en réalité les animaux les plus délicats de la ferme. Comme plus que tous les autres ils sont influencés par les changements brusques de température, on ne néglige rien pour leur assurer des abris convenables, des litières saines et sèches, une nourriture substantielle et de l'eau pure en abondance. Les plus grandes précautions sont aussi prises pour isoler les animaux malades, et après le décès, pour brûler ou enterrer leur corps." pp. 13, 14.



Translated, as follows :

"All American farmers know, to-day, that hogs are in reality the most delicate animals of the farm, as more than all others they are influenced by sudden changes of temperature. They neglect nothing to assure them suitable shelter with healthy and dry litter, substantial food and pure water in abundance. The greatest precautions are also taken to isolate sick animals, and after death to burn or inter them."

"Les pores Américains ont été examinés par des micrographes autorisés, étudiant avec soin chaque cas particulier, pendant qu'en Allemagne les 18,581 inspecteurs préposés à ces recherches étaient pour la plupart d'une, incompetence notoire et munis d'ailleurs d'instruments très défectueux." Which I translate as follows: "American hogs have been examined by authorized microscopists, studying with care each particular case, while that in Germany, the 18,581, inspectors charged with these researches, were, for the most part, of notorious incompetency, and were furnished with very defective instruments." (p. 19.)

In speaking of the hog cholera, the commission is represented as saying: "Ajoutons que l'inspection des viandes malades ou contaminées se fait avec trop de soins, sur toute l'étendue du territoire de l'Union, pour craindre un seul instant que l'on puisse impunément porter sur les marchés, à l'usage de l'alimentation publique, des animaux morts à la suite de cette affection." Freely translated, as follows: "Let us add, that the inspection of diseased, or contaminated meats is made with too much care throughout the whole extent of the territory of the Union, to fear for a moment that one can, with impunity, put upon the markets for public use as food, animals dying in consequence of this affection." (p. 31.) Again: "Mais, dans notre conviction intime, la surveillance et les inspections qui sont actuellement établies dans les grandes maisons d'approvisionnement et d'exportation sont plus que suffisantes pour satisfaire les esprits les plus timorés et pour justifier la liberté du commerce (restore the trade)." Translated as follows: "But, in our inmost conviction, the surveillance and inspections which are already established in the great provision and exporting houses, are more than sufficient to satisfy the mind of the most timid, and to justify the liberty of commerce (to restore the trade.)" (p. 32.) Again: "Après une étude et une enquête sérieuse sur toutes les circonstances afférentes aux conditions des pores Américains depuis, l'heure de la naissance jusqu'au moment où leur viande, convenablement préparée, est expédiée sur les ports étrangers, nous pouvons affirmer que nos pores, à tous les points de vue (infection par des parasites, maladies spéciales, détérioration des produits après l'abatage) sont supérieurs aux pores de France, d'Allemagne ou de toute autre contrée du globe." Translated: "After a serious study and enquiry into all the circumstances bearing upon the conditions of American hogs, from the hour of their birth to the time when their meat, suitably prepared, is sent to foreign ports, we can affirm that our hogs, in every point of view (infection by parasites, special diseases, deterioration of products after slaughtering,) are superior to the hogs of France, of Germany, or of any other country of the globe." (p. 33.)

I make one more quotation, from page 33, as follows: "Les recherches et examens microscopiques établissent clairement que la proportion pour cent des animaux infectés par la trichine est inférieure à la proportion que l'on trouve dans les autres pays Européens." Translated as follows; "Microscopical examinations and researches establish clearly that the proportion per hundred of the animals infected by trichina is inferior to the proportion found in European countries."

Did space permit I should make other quotations. I have not seen the original

English from which the above translations into French were made. The foregoing facts and statements have been given together, without comment, but it is very evident to any one who has read this report, or who makes enquiry, that there has been some misunderstanding as to some of the facts stated. All the gentlemen named are of the highest honor, and I could not think for a moment that any intentional misrepresentation would be made by them, or that they would purposely make a misstatement. The probability is that the letters have been imperfectly understood.

Messrs. Armour & Co.'s letters clearly show that no systematic examinations have been made at their establishment. The fact is that no pork establishment in America, doing a large business, has ever made regular inspections for trichinae.

Dr. Detmer's reports show that he examined 3,331 head of hogs, and found eighty infected with trichinae, while Mr. Brown's letter shows that only one out of 2,000 was rejected on account of the parasite.

As to the representations made by the Commission, as understood and given in Dr. Santa's pamphlet, I am very certain that the actual facts will not fully sustain them, and I think the representations intended to be made have been misunderstood. No such care of hogs is taken by the farmers of the West, as a general rule, as represented. Farmers are entirely too careless about burning and burying dead animals, and pay no attention, often, to isolation. Much improvement has, however, been made in this direction within the last few years, and it is to be earnestly hoped that the words of the Commission will soon be fully verified in every part of the land. Every effort in my power has been made to present the truth in regard to infection, and I believe this the true policy, and feel assured that proper inspection and care would soon greatly improve the reputation of our pork abroad, and at the same time add many millions of dollars to its value.

#### TRICHINÆ IN FROGS.

On the 2d of April, 1885, I received and examined a slide, prepared by Professor G. W. Worcester, Urbana, O., for the "American Postal Microscopical Club," containing a section of the stomach of a frog, stained with eosine and mounted in benzole balsam. The section contained, in the submucous tissue, what appeared to be a finely developed cyst with a trichina coiled up therein. The cyst was somewhat more rounded than usual, but very closely resembled the cyst of the trichina spiralis. The worm could with difficulty be seen so as to make out every part distinctly, and I am satisfied that it was not a true trichina spiralis, but some other nearly allied species.

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